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PESTICIDES ABSTRACTS (formerly Health Aspects of Pesticides Abstract Bulletin) is a monthly publication of the Technical Services Division of the Office of Pesticide Programs, Environmental Protection Agency.

The purpose of this publication is to foster current awareness of the major worldwide literature pertaining to the effects of pesticides as defined in the Table of Contents. The publication represents a monthly review of more than 2,000 primary and secondary sources. A list of periodicals from which articles have been abstracted appears annually in the January issue. Subjects and authors of abstracted articles are cross-referenced in quarterly and annual indexes. Reprint requests should be directed to the author of the complete article.

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75-2560. Painter, R. R.; Wedge, D. E. (Food Protect. Toxicol. Cent., Davis, CA). **Data bank of pesticides in the San Joaquin Valley.** *Calif. Agric.* 29(5): 4-6; 1975.

Beginning in 1969, the Food Protection and Toxicology Center of the University of California at Davis has been accumulating information on pesticide use in California in the form of a computerized data bank. Aided by funds from the National Science Foundation, a research project utilizing the information in the data bank to explore the feasibility of the systems approach to pesticide usage was developed in 1970. The study at present consists of 4 subprojects: data bank development, simulation modeling, chemical transformation of pesticides in air, and surveillance and estimation of pesticidal dissipation in soils. By 1974, the Food Protection and Toxicology Center data bank contained details of more than 2 million applications of over 600 million pounds of chemicals on 135 million acres. Each use report includes the formulation used, quantity applied, method of application, commodity treated, location, date of application, acres treated, purpose of usage, and applicator. The data on usage is incomplete, however, in that reports are not required for nonrestricted chemicals applied by farmers on their own or neighbors' property, for pesticides sold for use by home owners or home gardners, or for pesticides applied to federal lands by federal operators. The information on pesticides applied and commodities treated can be retrieved in many forms, including tabulations, summaries, graphs, and maps.

75-2561. Ehler, L. E.; Van den Bosch, R. (Div. Biol. Control., Univ. California, Berkeley, CA). **An analysis of the natural biological control of *Trichoplusia ni* (Lepidoptera: Noctuidae) on cotton in California.** *Can. Entomol.* 106(10): 1067-1073; 1974. (20 references)

The impact of natural enemies on California populations of the cabbage looper (*Trichoplusia ni* (Hueber) is reviewed. Substantial mortality during the developmental stage of this insect is inflicted by a complex of predators, several parasitoids (parasites), and a nuclear polyhedrosis virus. Loss of eggs and small larvae to predators is consistently the major factor influencing intrageneration mortality. Parasitization of *T. ni* larvae by any parasitoid seldom exceeds 30% in a given generation, and larval mortality due to polyhedrosis has been observed to reach levels of 50-60%. Based on this analysis, it is argued that natural enemies capable of effective colonization of the habitat and rapid exploitation of the prey population are suitable agents for the biological control of pests affecting annual or short-cycle crops. Polyembryony, polyphagy, and polyhedrosis represent attributes which enable the particular natural enemy to implement the rapid-host-exploitation strategy. This interpretation offers added theoretical basis to support the importation of exotic natural enemies of such pests.

75-2562. Anonymous. **Pesticides continue to face rough going.** *Chem. Eng. News* 53: 13; 1975.

The environmental effects of 2,4,5-T and phenoxy herbicides are discussed. The pesticide 2,4,5-T contains a minute amount of a contaminant TCDD produced during manufacture. In concentrations usually used for agricultural purposes, 2,4,5-T rapidly degrades and seldom persists for more than one growing season. The Environmental Protection Agency contends that it does persist and claims it has been detected in crop and animal products at levels that may be dangerous to man. When 2,4,5-T was used in Viet Nam in concentrations 3 or 4 times that used in domestic agriculture, no case of malformation or death could be unequivocally attributed to the herbicides. The phenoxy herbicides are rapidly excreted and metabolized by animals, plants, and microorganisms. They do not accumulate in the environment. The solubility of the phenoxy herbicides in fat is low, much below toxic levels. Studies testing the phenoxy herbicides for carcinogenicity conclude they are not a health hazard.

75-2563. Peoples, S. A. (Sch. Vet. Med., Univ. California, Davis, CA 95616). **Review of arsenical pesticides.** ***IN:*** ***Arsenical Pesticides,*** ACS Symposium Series 7, Woolson, E. A., ed., Washington, DC, American Chemical Society, 1975, p. 1-11. (18 references)

The use of new analytical methods will hopefully elucidate the role of arsenic in the ecosphere and may even demonstrate that it is essential in living tissue. The high levels in sea animals which are constant in value and not related to industrial or agricultural pollution suggest this possibility. Arsenic compounds can be absorbed by any route although the usual entry is by ingestion. Blood measurements are useful in measuring the body burden and rate of change in the body. The route of excretion is via the urine and feces. It has been found that a methanobacterium can methylate inorganic arsenic to form dimethyl arsonic acid and dimethyl arsine under anaerobic conditions. Unlike mercury, methylation of arsenic causes a great reduction in toxicity and is a true detoxication process. The toxic dose for rats or arsenical herbicides is given. The mechanism of toxicity is considered due to the binding of -SH groups of lipoic acid by trivalent arsenic. The question of arsenic as a cause of cancer has yet been resolved. While much research needs to be done, enough is known about the useful and toxic effects of arsenic compounds so that their use as pesticides and feed additives can be carried out with safety.

75-2564. Environmental Protection Agency. (Washington, DC 20460). **DDT: A review of scientific and economic aspects of the decision to ban its use as a pesticide.** ***EPA, Washington,*** 300 p, 1975. (495 references)

Much more literature is available on the effects of DDT on fish and wildlife than was available at the time FDA rulings cancelled its use. Such literature is reviewed. None of the newer findings in any way disagree with the earlier investigations. Indeed, certain behavioral effects on wildlife that were not known in 1972 have since been established. Prior and current literature and data on the

carcinogenicity of DDT are also reviewed. DDT is identified as a carcinogen in mice, and a potential carcinogen in man. Valid epidemiological studies of human effects of DDT are still lacking as are laboratory studies in species other than the mouse. No large increase in incidents of DDT risk to human health has been reported since cancellation. Efforts have been made to protect against acute health defects by user education and worker reentry standards. The economic aspects of DDT cancellation are also reviewed. Application to cotton was the major use of DDT prior to the cancellation, amounting for more than 80% of the DDT used domestically. Alternative insect controls, chemical and non-chemical, are available although there are pest resistance problems in some areas and, at times, a marked scarcity of supplies. The national impact of increased costs for cotton crop protection on the consumer of cotton amounted to about 2.2 cents/capita/yr. Production and yield of minor crops are also discussed.

75-2565. Beaconsfield, P.; Krebs, H.; Borlaug, N.; Rainsbury, R. (Special Comm. Intern. Pollut., Bedford Coll., Univ. London, London, England). **Man-made chemicals and our milieu interieur: a preliminary report from the special commission on internal pollution.** *Experientia* 31(7): 869-872; 1975. (7 references)

The benefit-risk concept associated with modern chemicals is discussed. Three separate factors need assessing: the benefits a compound can confer, the dangers of taking it, and the consequences of withholding it. There is no such thing as a safe chemical. Compounds should be evaluated from the point of view of the benefits they confer and any hazard their use entails, and a benefit:risk ratio commensurate with the situation concerned should be sought. Cost is another factor that has to be taken into account. Pesticides, fertilizers, and other agricultural or livestock improvers are almost universally used. These, together with the genetically improved crops, have produced a new concept—the farming equivalent of positive health—the so-called green revolution.

75-2566. Anonymous. **Time to take the offensive.** *Farm Chem.* 138(8): 13; 1975.

Agriculture is urged to take a legal offensive against the Environmental Protection Agency and fight for pesticide use. Regulations and restrictions were established by the EPA that are excessively demanding and that will smother new pesticide development, cut down on present use, and force farmers into situations where they take chances with the law in order to protect their crops. Cooperation and compromise have not worked and court action is recommended.

75-2567. Anonymous. **Congress: don't look for much help.** *Farm Chem.* 138(8): 14-21,24; 1975.

A series of reports on the pesticide activities of the Environmental Protection Agency is presented. Although there is disagreement in Congress over the EPA's implementation of the Federal Envirionmental Pesticide Control Act (FEPCA), no major changes are expected in the law. Congress may issue a 1 yr authorization rather than 2-3 yr so that the Agriculture Committee can exercise closer oversight control. Areas of grave concern in Section 3 of the FEPCA include the discarding of the negligible residue concept, changing the term carcinogenic to oncogenic, definition of use and introduction of rebuttable presumption. By Oct. 21, 1976, every pesticide must be federally registered and meet all data requirements spelled out in the FEPCA and the regulations promulgated under it. The data requirements pose the most serious problem, both short and long term, to registration of pesticides for use on fruits, vegetables, ornamentals, spices, and other specialty crops where the acreage involved and/or the amount of pesticide used does not begin to offset the cost of development and registration ($8-10 million). The classification system is confusing and industry is opposed to the presumptive list being published. There is additional debate between the EPA and the House Agriculture Committee on the regulations involving the certification of private applicators.

75-2568. Berg, G. L. (Farm Chemicals, Willoughby, OH 44094). **It's time to bring the EPA to court!** *Farm Chem.* 138(8): 68; 1975.

The activities of the Pacific Legal Foundation involving the use of pesticides and herbicides are discussed. Unlike the Environmental Defense Fund and other radical environmental groups, Pacific Legal Foundation is opposed to those who use environmental considerations, under the guise of protecting the environment, to stop needed social and economic activities. Since the Foundation was incorporated as a non-profit, legal foundation in 1973 it forced the Environmental Protection Agency to issue an order allowing the emergency use of DDT against the Tussock moth in the forests of Washington and Oregon. It also forced the Sierra Club to back down when it brought suit against the U.S. Forest Service to prohibit the use of herbicides in the national forests.

75-2569. Ricker, W. E. (Author address not given). **The Fisheries Research Board of Canada—seventy-five years of achievements.** *J. Fish. Res. Board Can.* 32(8): 1465-1490; 1975. (3 references)

The idea of having government research supervised by a group of knowledgeable individuals outside of the government service began, in Canada, in the field of aquatic science and fisheries. In 1898 an honorary Board of Management was set up to establish and manage a biological station on the Atlantic coast. As this Board's responsibilities increased it was renamed the Biological Board of Canada, and finally the Fisheries Research Board of Canada. Starting in 1973 the Board ceased to have direct responsibility for the management of research stations, but it continues as an advisory body. During the period 1898-

1972 the Board has provided facilities for original research on aquatic animals and plants and on the waters they inhabit, much of it done by scientists from universities and museums; it has solved many problems faced by governments in locating, evaluating, managing and increasing fish stocks; and it has assisted the fishing industry with improved techniques for catching, handling processing and marketing its products. The immediately useful results of the Board's work have been made available to the Canadian community through reports, publicity and personal contacts. Details of scientific discoveries have been published in the Board's *Journal* and other outlets, while results of research done in other countries have been sifted and interpreted for their application to the Canadian scene. (Author abstract by permission)

75-2570. Metcalf, R. L.; Luckmann, W. H. (Author address not given). **Introduction to insect pest management.** John Wiley & Sons, New York, 1975, 587 p.

The subject of insect pest management is introduced and examples are provided of developing programs and techniques in pest management for use by students and field workers in pest control. Individual chapters deal with the pest-management concept, ecological aspects of pest management, the economics of pest management, plant resistance in pest management, parasitoids and predators in pest management, use of disease in pest management (abstracted separately), insecticides in pest management, attractants, repellents, and genetic control in pest management, the quantitative basis of pest management, and analysis and modeling in pest management. Application of these topics is then discussed in sections dealing with the management of insect pests affecting cotton, forage crops, tree fruits, forests, man, and domestic animals. References and selected readings are provided at the end of each chapter and a discussion of pest management and the future is included as an epilogue.

75-2571. Maddox, J. V. (Author address not given). **Use of diseases in pest management.** *IN: Introduction to insect pest management.* R. L. Metcalf and W. H. Luckmann, Eds. John Wiley & Sons, New York, 1975, p. 189-234. (83 references)

The types of pathogens occurring in insects and the use of these pathogens in pest-management situations are discussed. The characteristics of insect diseases are examined with regard to transmission, host range, persistence of insect pathogens, and pathogenicity. The major groups of insect pathogens include viruses, bacteria, fungi, protozoa, and nematodes. Among the most important viruses are the nuclear polyhedrosis viruses, the granulosis viruses, the cytoplasmic polyhedrosis viruses, and several other inclusion viruses. Non-spore-forming and spore-forming bacteria are considered separately. Additional topics include insect diseases as naturally occurring mortality factors, the introduction and application of insect diseases for long-term suppression, the role of microbial control in pest-management programs, and the production, standardization, formation, application, registration, and economic aspects of microbial insecticides. Examples of insect control with microbial insecticides are provided. Many insect pathogens have been successfully used in insect-control programs, and as the problems involved in their use are solved, insect pathogens will play an increasingly important role in pest-management programs.

75-2572. Semal, J. (Assoc. Etudes Rech. Zool. Appl. Phytopathol., Gembloux, Belgium). **Avant-propos et synthese de la discussion—Table ronde sur les aspects scientifiques et techniques de la pollution par les pesticides et les metaux lourds (2 mai 1973). [Foreword and discussion—Round table on the scientific and technical aspects of pollution by pesticides and heavy metals (May 2, 1973).]** *Parasitica* 30(1): 1-2,24-27; 1974. (French)

A panel discussion on technical and environmental aspects of pesticides is presented. The resistance of insect populations to insecticides should be prevented by the alternate use of different preparations. Herbicides and other pesticides should be used mostly in cases of necessity rather than prophylactically. The damage afflicted by pests is sometimes smaller than the risks and costs involved in the use of pesticides. Different degrees of accumulation of pesticide residues were observed in birds of different species which are at the same level of the trophic chain.

75-2573. Martens, P. H. (Fac. Sci. Agron., Gembloux, Belgium). **Points de vue. [Points of view.]** *Parasitica* 30(1): 4; 1974. (French)

The attitudes and trends in connection with the production, utilization, and analysis of pesticides, and hygienic aspects of pesticide residues in food are summarized. The development of new pesticides is characterized by products with increased selectivity against parasites and reduced toxicity for higher animals. Users of pesticides are often inclined to use excessive doses of the preparations and to use them at times when use is not justified. In regular consumption of foods containing pesticide residues, the acceptable daily intake must not be reached.

75-2574. Herman, P. (Inst. Rech. Chim., Minist. Agric., Tervuren, Belgium). **Pollution par les metaux lourds, specialement le mercure. [Pollution by heavy metals, especially mercury.]** *Parasitica* 30(1): 22-23; 1974. (French)

General ecological and hygienic problems of mercury from industrial and agricultural sources are outlined. Non-methylated industrial mercury compounds become gradually methylated by microorganisms, while the relatively small quantities discharged in agriculture are already in the more toxic methylataed form. Mercury residues may be unacceptably high in certain fish, while other foods and water contain mercury in the ppb range. Mercury residues

in foods tend to be bound to proteins. The admissible daily intake has been set at 0.03 mg, and the maximum allowable residue level in foods is 0.1 ppm, and sometimes 0.5 ppm.

75-2575. Detroux, L. (Stn. Phytopharm. Etat, Gembloux, Belgium). **Evolution des nouvelles matieres actives. [Development of new active ingredients.]** *Parasitica* 30(3): 85-86; 1974. (French)

New herbicidal substances introduced or proposed recently are reviewed. Ipuron, a new urea derivative; and mesoprazine, dimethametryne, and cyprazine, derivatives of triazines, have been introduced recently. Triazinones, diazines, substituted amides and anilides, benzonitrile derivatives, dipyridilium derivatives, dinitroanilines, diphenylethers, benzoylanilidopropionates, and glycine derivatives are among the new herbicides suitable for use in agriculture, on marshlands, and for industrial weed control.

75-2576. Peakall, D. B. (Sect. Ecol. Systematics, Langmuir Lab., Cornell Univ., Ithaca, NY 14850). **Phthalate esters: occurrence and biological effects.** *Residue Rev.* 54: 1-41; 1975. (177 references)

The annual production of phthalates in the United States is nearly half a million tons and total world production is estimated at two million tons. Phthalates appear to be natural constituents of some plants; evidence for endogenous occurrence in animals is less convincing. The acute toxicology of all phthalates is low and chronic experiments show a high "no-effect" level. Evidence of carcinogenic properties is negative, but several phthalates are teratogenic at high doses. The risk at environmental levels remains to be assessed. A considerable body of research has been done on the elution of phthalates from plastic by blood. No physiological effects have definitely been ascribed to these compounds at these levels. Accumulation factors of di(2-ethylhexyl) phthalate at the lower trophic levels are high. Since metabolism is rapid in mammals, it is likely that maximum residue levels will occur at intermediate trophic levels rather than the top of the food chain. Current environmental residue data are not adequate to confirm this prediction. (Author abstract by permission)

75-2577. Anonymous. **Pestizid-Boom und Umwelt-Belastung. [The pesticide boom and environmental stress.]** *Umschau Wiss. Tech.* 75(11): 347-348; 1975. (German)

Reflections and responses are presented to questions raised in recent articles on general environmental effects of the use of pesticides in agriculture. Biological methods of pest control, though available for certain crops on a small scale, can not be expected to replace conventional chemical pest control at least in the foreseeable future for economic and technical reasons. The generally observed reduction of partridge populations in Europe can not be ascribed solely to the use of pesticides. The use of herbicides and growth hormones in farming and gardening will be justified as long as there is no demonstrable hazardous contamination.

75-2578. Tejedor Gilmartin, C.; Murado Garcia, M. A.; Baluja Marcos, G. (Inst. Quim. Organ. Gen., Madrid, Spain). **Contaminacion del medio por plaguicidas organoclorados. VIII. Estudio del proceso de adsorcion/desorcion de lindano y aldrin en un suelo agricola y en sus componentes humicos y arcillosos.** [**Environmental contamination by organochlorine pesticides. VIII. Adsorption/desorption processes of lindane and aldrin in a farm soil and its clay and humus components.**] *An. Quim.* 70(12): 1177-1183; 1974. (13 references) (Spanish)

Adsorption and desorption of lindane and aldrin were investigated by GLC quantitation of eluates obtained from leaching aqueous solutions of these pesticides through columns of soil and soil components. The Ferbenza soil used had values of 4.7% carbon, 7.9% organic matter, pH 5.4, 65.5% sand, 20.5% humus, and 13.9% clay. The clay fraction of the soil was isolated by repeated treatment of a particulate suspension with hydrogen peroxide and acid washing to remove the carbonates. The humic fraction was isolated by extracting a soil solution with 1% sodium pyrophosphate, then acidifying to pH 1 with sulfuric acid to precipitate the humic acids. The complete soil or appropriate fraction, supported if necessary on an inert carrier, was packed in a Pyrex column and a solution percolated through. The quantity of lindane retained by the complete soil gradually decreases during the adsorption process; addition of a $CaCl_2$ solution results in practically complete elution of the amount applied. Lindane adsorption by the clay fraction was very limited, whereas desorption took place quite rapidly. Only part of the retained lindane was recovered in the eluate. The adsorption/desorption pattern in the organic fraction followed the same pattern as in the complete soil. Results with aldrin were difficult to interpret, probably due to interference by the support, but aldrin was adsorbed more rapidly and retained more firmly on the whole than lindane.

75-2579. D'Aubert, S.; Renon, P.; Cantoni, C. (Ist. Isp. Aliment. Orig. Anim., Univ. Studi, Milan, Italy). **Il mercurio nelle carni di pesce.** [**Mercury in fish.**] *Arch. Vet. Ital.* 25(5-6): 175-183; 1974. (2 references) (Italian)

The problem of mercury pollution has attained the status of a cause celebre; unfounded statments can only be combatted by accurate data. Information was gathered concerning the mercury levels in tissues of fishes collected from various parts of the Mediterranean, Atlantic, and other seas. Mercury levels in swordfish from the Atlantic and Pacific Oceans were below 1 ppm, whereas in swordfish from the Central Mediterranean, Ligurian, Tyrrhenian, and Western Mediterranean they averaged 1.98, 1.48, 1.61, and 1.82 ppm. Sharks of various species captured in the Indian, Pacific, and Mediterranean Oceans rarely contained mercury levels in excess of 1 ppm. Tuna contained mercury levels ranging from an average of 1.19 ppm for albacore in the central Mediterranean to 2.5 ppm for tuna of the Tyrrhenian and Ligurian Oceans. Mercury in fish is generally considered to reflect the mercury levels of waters and sediments, mostly of natural origin. However, the mercury production processes occurring in the countries around the Mediterranean may have contributed to pollution of this ocean. The mercury levels encountered may pose some threat in areas where large amounts of fish are consumed.

75-2580. Hiltbold, A. E. (Agronomy Soils Dep., Agric. Exp. Stn., Auburn Univ., Auburn, AL 36839). **Behavior of organoarsenicals in plants and soils.** *IN: Arsenical Pesticides, ACS Symposium Series 7,* Woolson, E. A., ed., Washington, DC, American Chemical Society, 1975, p. 53-69. (32 references)

The more commonly used organic arsenical herbicides include the sodium or ammonium salts of MAA (methanearsonic acid), MSMA (monosodium methanearsonate), DSMA (disodium methanearsonate), and MAMA (monoammonium methanearsonate). Methanearsonates are used most extensively for postemergence control of annual grass weeds in cotton. Selective control of crabgrass and dallisgrass in established turf is provided by the methanearsonates with minimal injury of most turfgrasss species. The primary pathway of entry into plants is through the leaves and stems. Absorption usually occurs within several hours after application. Surfactants are included in spray solutions to increase coverage and enhance absorption. Plant species differ in their sensitivity to methanearsonates, probably due in part to differences in permeability of leaf surfaces. The translocation of the herbicide out of the treated tissue and into more critical sites of activity is essential. Accumulation at these active growth sites suggests that meristematic tissues are the major points of herbicidal activity. There is no evidence of substantial degradation or rupture of the C-As bond of organoarsenicals in plants. The behavior of organoarsenicals in soil is discussed from the view points of adsorption, leaching, metabolism, persistence, and uptake by crops.

75-2581. Sandberg, G. G.; Allen, I. K. (Ansul Co., Weslaco, TX 78596). **A proposed arsenic cycle in an agronomic ecosystem.** *IN: Arsenical Pesticides, ACS Symposium Series 7,* Woolson, E. A., ed., Washington, DC, American Chemical Society, 1975, p. 124-147. (81 references)

The presence of a natural arsenic cycle has been confirmed, but the long-term effects of man-made arsenic inputs on thic cycle remain uncertain. A model is proposed to give some perspective on the impact of organic arsenical herbicides in an agronomic ecosystem. However, many of the transfers involved would certainly be applicable to other ecosystems. The reduction of arsenicals to methylarsines, soil erosion, and arsenic uptake were the primary redistribution mechanisms considered in this model. Since the soil is the ultimate sink for arsenic, a budget for soil was arranged. Values presented are theoretical and reflect conditions which favor a build-up of arsenic in soil. It is suspected that an equilibrium will occur in soil at which methylarsine losses equal organic inputs, but this

has not yet been clearly demonstrated. From the data considered in this model, it was concluded that arsenic is mobile and nonaccumulative in the air, plant, and water phases of the agronomic ecosystem. Arsenicals do accumulate in soils, but redistribution mechanisms preclude hazardous accumulations at a given site.

75-2582. Stolzenberg, J. E. (Inst. Environ. Studies, Univ. Wisconsin, Madison, WI 53706). **Simulation of the mobility of arsenic compounds in the environment: a southern Texas case study.** *IN: Arsenical Pesticides, ACS Symposium Series 7,* Woolson, E. A., ed., Washington, DC, American Chemical Society, 1975, p. 148-171. (53 references)

The development is reported of a computer simulation model designed to integrate diverse information on the mobility of a selected chemical in a regional environment. Since it is impossible to derive all the mass transport equations describing such a complex, multidimensional system, the model was formulated probabilistically, rather than deterministically. A flow path is constructed for an indivisible portion of the chemical. Then flow path construction is repeated many times, and the distribution is averaged in order to predict the representative behavior of the chemical. To cope with the large data requirements, the model can incorporate either objective or subjective quantifications of the processes influencing the chemical being simulated. Thus, the model can be viewed as a tool which augments experts' understanding of the behavior of specific compounds in a selected system. A case study to which the model has been applied is included. This study involved predicting the fate of disodium methanearsonate and its derivatives after it had been applied by cotton farmers in Southeastern Hidalgo County, Texas.

75-2583. Walsh, L. M.; Keeney, D. R. (Dep. Soil Sci., Univ. Wisconsin, Madison, WI 53706). **Behavior and phytotoxicity of inorganic arsenicals in soils.** *IN: Arsenical Pesticides, ACS Symposium Series 7,* Woolson, E. A., ed., Washington, DC, American Chemical Society, 1975, p. 35-52. (62 references)

The relation between arsenic sorption and soil properties and the possible mechanisms of arsenic sorption in soils are reviewed. Various soil test methods are presented in terms of their ability to predict arsenic uptake and phytotoxicity. The relations are considered between soil arsenic and plant uptake, which results in phytotoxicity, and potential hazards to humans or animals consuming plants grown on soils containing high levels of arsenic. Methods of ameliorating arsenic toxicity are discussed, including the addition of sufficient phosphate to the system to depress arsenate uptake by the plant, addition of iron or aluminum compounds, cultural pactices, and leaching.

75-2584. Walter, M.; Czaplicki, E. (Inst. Food Technol., Poznan, Poland). **Zanikanie chlordimeformu w jablkach. [Dynamics of chlordimeform degradation in apples.]** *Biul. Inst. Ochr. Rosl.* 54:393-398; 1972. (5 references) (Polish)

Chlordimeform and its degradation products were analyzed in Johnathan apples after application in a State Farm orchard in 1972. Samples were treated with acetic acid and sodium hydroxide following hydrolysis of chlordimeform and its potential metabolite, 4-chloro-*o*-toluidine. The aromatic amine was distilled off and extracted with isooctane in the Bleidner apparatus, then diazotized and iodinated. The derivative was then analyzed by gas chromatography with an electron capture detector. Total residues determined in this manner declined from 3.20 ppm on the day of treatment to 2.50 ppm on the third day, 0.90 ppm on the seventh day, 0.75 ppm on the fourteenth day, and 0.27 ppm on the forty-seventh day. Residue levels of 0.10 ppm were still present on the apples 77 days after treatment. The recommended provisional acceptable contamination level according to FAO/WHO is 3 ppm.

75-2585. Bartl, P.; Korte, F. (Inst. Chem., Tech. Univ., Munich, Germany). **Beitraege zur oekologischen Chemie. 98. Photochemisches Verhalten des Herbizids Sencor (4-Amino -6- *tert*-butyl -3- (methylthio) -1,2,4- triazin-5(4H) -on) in Loesung. [Contributions to ecological chemistry. Part 98. Photochemical characteristics of the herbicide Sencor (4-amino -6- *tert*-butyl -3- (methylthio) -1,2,4- triazin-5-(4H)-one) in solution.]** *Chemosphere* 4(3): 169-172; 1975. (10 references) (German)

The photochemical metabolism of Sencor (metribuzin) dissolved in methanol or acetone was studied. Irradiation in methanol resulted in metabolite II as described by Zabig and Pape as the chief metabolite; in 4% 6-*tert* -butyl-1,2,4-triazin -3,5- (2H,4H)-dione; and in 2% 4-amino -6-*tert* -butyl- 1,2,4-triazin- 3,5-(2H,4H)dione. The ammonium salt of methane sulfonic acid was also isolated. Irradiation in acetone resulted in the same metabolites in largely the same proportions, and in a condensation product of the solvent with the initial compound (4-isopropylideneamino -6- *tert*-butyl -3- (methylthio) -1,2,4-triazin-5-(4H)- one at a rate of 5%. Hydrolytic or oxidative cleavage may be responsible for removal of the methylmercapto group.

75-2586. Bartl, P.; Korte, F. (Inst. Chem., Tech. Univ., Munich, Germany). **Beitraege zur oekologischen Chemie. 99. Photochemisches und thermisches Verhalten des Herbizids Sencor (4-Amino -6- *tert*-butyl -3- (methylthio) -1,2,4-triazin- 5(4H)-on) als Festkoerper und auf Oberflaechen. [Contributions to ecological chemistry. Part 99. Photochemical and thermal characteristics of Sencor (4-amino -6- *tert* -butyl-3- (methylthio) -1,2,4- triazin-5(4H)-one) as a solid and on surfaces.]** *Chemosphere* 4(3): 173-176; 1975. (4 references) (German)

The photochemical and thermal behavior of Sencor (metribuzin) as a solid and on surfaces was studied. When irradiated as a solid, it was deaminated only in the presence

of moisture. Heating at 110°C for 20 hr caused no change. Irradiation of Sencor applied to silica gel for 60 hr resulted in degradation to three products, one of which was predominant. Rapid thermic conversion of Sencor applied on silica gel was observed upon heating. While the transformation pathway was the same, the process was much slower on sea sand. This difference may be due to differences in the specific surface and activities of these surfaces because Sencor applied to surfaces is typically degraded by removal of the methylmercapto group as a result of weakening of the C-S bond.

75-2587. Mansour, M.; Parlar, H.; Korte, F. (Inst. Chem. Tech. Univ., Munich, Germany). **Reaktionsverhalten von 3,4 Dichloranilin and 3,4 Dichlorphenol in Loesung, als Festkoerper und in der Gasphase bei UV-Bestrahlung.** [**Reaction characteristics of 3,4-dichloroaniline and 3,4-dichlorophenol in solution, as solids, and in gaseous phase on UV irradiation.**] *Chemosphere* 4(4): 235-240; 1975. (11 references) (German)

The degradation of 3,4-dichloroaniline, a metabolite of diuron, linuron, propanil, karsil and dicryl, and of 3,4-dichlorophenol, a metabolite of propanil, was studied as a solid, in solution, and in gaseous phase under UV light. A solution of 3,4-dichloroaniline in a 1:1 mixture of water and methanol resulted in such metabolites as *p*-chloroaniline, aniline, 3,3',4,4'-tetrachloroazoxybenzene (from 3,4-dichloroaniline), a dechlorination product of the latter, and hydrazobenzene. Irradiation as a solid yielded *p*-chloroaniline and three metabolites, and irradiation in gaseous phase at wavelengths below 290 nm yielded *p*-chloroaniline and aniline at very small yield rates. Irradiation of 3,4-dichlorophenol in a 1:1 mixture of water and methanol yielded hydroquinone, quinone and 7 more metabolites. Solid 3,4-dichlorophenol yielded three metabolites, and two metabolites were isolated after irradiation in the gas phase.

75-2588. Kotzias, D.; Lay, J. P.; Klein, W.; Korte, F. (Inst. Oekol. Chem., Gesellschaft fuer Strahlen- und Umweltforsch. mbH, Munich, Germany). **Rueckstandsanalytik von Hexachlorbutadien in Lebensmitteln und Gefluegelfutter.** [**Hexachlorobutadiene residue analysis in food and poultry feed.**] *Chemosphere* 4(4): 247-250; 1975. (4 references) (German)

Poultry feed and foods purchased in supermarkets in the Bonn area in April 1975 were analyzed for hexachlorobutadiene residues. Chromatographic clean-up and a gas-chromatographic method were applied for analysis. No residue was found in eggwhite, chicken drumsticks, turkey liver, butter, tuna, sardines, or ground beef. The residues found in powdered milk, eggyolks, vegetable margarine, granular poultry food (a mixture of corn, wheat and oats), and feed meal were 4 ppb, 42 ppb, 33 ppb, 39 ppb, and 2 ppb, respectively.

75-2589. Gaeb, S.; Nitz, S.; Parlar, H.; Korte, F. (Inst. Oekol. Chem., Munich, Germany). [**Studies on ecological chemistry. Part 105.**] **Photomineralization of certain aromatic xenobiotics.** *Chemosphere* 4(4): 251-256; 1975. (5 references)

The behavior of hexachlorobenzene, pentachlorobenzene, PCP, DDT, DDE, 2,4,5,2',4',5'-hexachlorobiphenyl, and 2,5,2',5'-tetrachlorobiphenyl in the presence of a large excess of oxygen exposed to UV-light with wavelengths $\lambda > 230$ nm (quartz glass) as well as with wavelengths $\lambda > 290$ nm (pyrex glass) was investigated. It was noted that the conversion rates of the substances adsorbed on particulate matter were far higher than with those deposited as solids or thin films on a glass surface. These differences are attributed to the bathochromic shift, changes in the relative extinction or appearance of new absorption bands as a consequence of the adsorption on silica gel, and greater dispersion of pesticide molecules in the adsorbed phase resulting in greater pesticide/oxygen contact. The disappearance of the applied substances can neither be explained by the vapor pressure of substances nor is it due to the formation of photoproducts. Since carbon dioxide and hydrochloric acid are formed during pyrex lamp irradiation of PCP, DDT, and DDE as solids on glass and the UV-absorption bands of these compounds are located nearly in the same region as those of the substances adsorbed on silica gel, it is deduced that in this case mineralization products are evolved. Measurements of the reaction rates leading to mineralization by means of application of labeled compounds are currently under investigation.

75-2590. Comstock, E. G. (Inst. Clin. Toxicol., Houston, Tex.) **Urinary excretion of pentachlorophenol in an occupationally exposed population.** *Clin. Toxicol.* 7(2): 208, 1974.

A method for determining the extent of occupational exposure to pentachlorophenol by measuring the extent of urinary excretion is described. Over a 2½ yr period, urinary excretion was determined in 64 individuals involved in the manufacture of pentachlorophenol. The urinary concentration was higher during summer months and increased after accidental increase in exposure. There is no apparent relation between urinary excretion of pentachlorophenol and illness with clinical symptoms compatible with pentachlorophenol exposure. It is believed that impairment of excretion precedes the appearance of clinical illness.

75-2591. Doneche, B.; Seguin, G. (Inst. Oenologie, Talence, France). **La degradation du "mancozebe" (produit de coordination de l'ion zinc avec l'ethylene-bis-dithiocarbamate de manganese) dans les sols de vignobles.** [**Degradation of mancozeb (coordination product of zinc ion with manganese ethylene-bis-dithiocarbamate) in vineyard soils.**] *C. R. Hebd. Acad. Sci. Ser. D* 280(19):2265-2268; 1975. (5 references) (French)

The degradation of mancozeb in six different vineyard soils with different pH values and different organic matter and clay contents was studied in laboratory experiments using absorption spectrophotometry. Mancozeb was added to the soils at a rate of 60 mg/kg. Very rapid degradation of the fungicide was observed during the first 120 hr due to oxidation and biodegradation. The latter was responsible for 30% of the degradation. The subsequent slowdown of degradation may be due to stabilization of the product and to the protective action of soil colloids. At the time, biodegradation became predominant. Quantitative degradation was achieved in normal soil in about 1,000 hr, while 25-48% of the substance was intact in sterilized soil after 1,500 hr. The active agent was degraded essentially to sulfur and ethylenediamine in 1,500 hr.

75-2592. Lunde, G.; Steinnes, E. (Cent. Inst. Ind. Res., Oslo, Norway). **Presence of lipid-soluble chlorinated hydrocarbons in marine oils.** *Environ. Sci. Technol.* 9(2): 155-157; 1975. (13 references)

The total amount of chlorine present as lipid-soluble chlorinated hydrocarbons is determined in marine oils from fish, shrimp, and whale. The oils are isolated by heat treatment and also by extraction with suitable organic solvents. The level of chlorine varies from about 20-650 ppm in the samples investigated. It is concluded that the larger part of this lipid-soluble organic-bound chlorine can hardly be accounted for by known substances. The substances may in part be synthesized by natural means in the marine environment. The absorption of unidentified chlorinated pollutants is another possible source. Bromine and iodine have been determined as well to allow comparison with previously obtained data. (Author abstract reprinted by permission of the American Chemical Society)

75-2593. Hopkins, H. (Author address not given). **Finding out what else you eat.** *FDA Consumer* 9(6): 8-15; 1975.

The FDA has been conducting a study over the past 10 yr of the kinds and amounts of pesticide residues, heavy metals, and industrial chemicals consumed along with food by the typical 15 to 20 yr old American male. This Total Diet Study supplements FDA's routine and sometimes special surveillance of foods for regulatory purposes. Regulatory checks are performed on foods as they travel on the route to the market. Total Diet Study, however, is performed on the finished products that are ready to eat, either as marketed or as prepared by the agency for typical meals, and thus reflects actual intake of residues by the consumer. Analytical results are not measured against the tolerances and action guidelines used by the FDA in enforcement, but rather against the daily intake levels of contaminants considered acceptable and not harmful to human health by the Food and Agriculture Organization of the United Nations and by the World Health Organization Expert Committee. FDA also uses the results of the total diet study to track trends in occurrences of pesticides, polychlorinated biphenyls and heavy metals in certain classes of foods or in certain geographical areas over extended periods. Analysis of the data for the annual Total Diet Study for fiscal 1973 included 117 individual food items for each of 30 representative areas of the country. This study showed DDT occurrence frequency and levels have declined dramatically from earlier years due to the ban on DDT use. DDE remains prevalent, especially in foods of animal origin. Residues of the insecticide dieldrin declined somewhat from the late 1960's and were 40% of the WHO-FAO Acceptable Daily Intake (ADI). Daily intakes of organophosphorus insecticides malathion and diazinon have increased about 50% over the 1965-1970 period, but still remain far below the ADI limits. Polychlorinated biphenyls occurred at very low levels, primarily in the meat-fish-poultry composites, perhaps due to environmental contamination, and in grain-cereal composites, attributable to contamination by recycled paper used in food packaging. The average intake of mercury was 7% of the ADI, down a third from fiscal 1972. Arsenic intake has declined substantially from the 1965-1970 average, probably because of changes in the use of pesticides containing arsenic. An infant-toddlers study is also conducted.

75-2594. Vrochinskiy, K. K.; Soboleva, L. P.; Buslenko, A. L.; Alekhina, S. M.; Sokur, A. I. (Inst. Hyg., Toxicol. Pestic., Polymers and Plastics, Kiev, USSR). **Nekotoryye voprosy gigieny truda pri primenenii polikhlorkamfena svekoovodstve. [Some issues of occupational hygiene in dealing with polychlorocamphene used in sugar beet growing.]** *Gig. Tr. Prof. Zabol.* 6: 8-11; 1975. (9 references) (Russian)

Detection of polychlorocamphene (PCC, toxaphene) in the treatment of sugar beets is reported. After two-fold treatment of a sugar beet field plot with PCC dispersed by a tractor sprayer (2 kg/hectare), the compound was detectable in the air (0.2 mg/m^3 on 10th day), in soil, and in the plants (0.7 mg/kg on the 7th day). Found on workers' skins, PCC, in short-term exposure, brought about changes in electrolyte balance and in the isoenzymatic spectrum of LDH. The compound should be severely limited and subsequently replaced with another pesticide due to its high stability in soil and water, its ability to amass in living organisms, and its high toxicity.

75-2595. Edwards, V. H.; Schubert, P. F. (Sch. Chem. Eng., Cornell Univ., Ithaca, NY). **Removal of 2,4-D and other persistent organic molecules from water supplies by reverse osmosis.** *J. Am. Water Works Assoc.* 66(10): 610-616; 1974. (92 references)

Reverse osmosis was investigated as a technique for freeing water of persistent molecules such as 2,4-D and as a method for concentrating aquatic pesticides prior to analysis. In common with adsorption on active carbon and solvent extraction, reverse osmosis showed varying selectivity for pesticide residues depending on the specific residue, its concentration, the membrane used, and the pre-

sence of other solutes. Pesticides such as DDT with very low aqueous solubilities are more efficiently removed via reverse osmosis than are compounds such as 2,4-D, which is sparingly soluble, or phenol, which is highly soluble in the membrane. Reverse osmosis remains a candidate for water-sample concentration prior to pesticide analysis, but additional study of the removal of pesticides and other refractory organics by this technique is needed. Concentrated aqueous waste from reverse-osmosis plants may be a problem, although activated-sludge treatment of the reject stream from the reverse-osmosis concentration of sewage is technically feasible. Many new or comparatively untried membranes offer hope for several-fold higher flux rates at equal retention; this would lower initial reverse-osmosis plant costs on membrane costs.

75-2596. Shafter, M. A. M.; Zabik, M. E. (Dep. Food Sci. Human Nutr., Michigan State Univ., East Lansing, MI 48824). **Dieldrin, fat and moisture loss during the cooking of beef loaves containing texturized soy protein.** *J. Food Sci. (Chicago)* 40(5): 1068-1071; 1975. (19 references)

A study was conducted to determine if a substantial decrease in cooking loss of dieldrin would occur with the addition of various levels of texturized soy protein (TSP) into a meat-loaf system. Lean chuck sections of Hereford beef, removed from market as it contained greater than the allowed 0.3 ppm dieldrin, were made into meat loaves containing 0, 10, 20, 30, and 50% rehydrated texturized soy protein. The fat content of the raw meat loaves decreased as the level of TSP substituted increased. However, this decrease was not proportional to the percentage of soy protein added. The use of TSP in the meat loaves has a binding effect on the fat. A very highly significant negative correlation was found between fat content of the meat loaves and the cooking time. All the raw meat loaves contained significantly more moisture than the cooked loaves. Losses which occurred through drip showed a consistent decrease with increased substitution. On the basis of fat, the raw meat loaves with 30 and 50% TSP showed significantly higher dieldrin levels than those with 0, 10, or 20% TSP. The dieldrin content of the cooked meat loaves was lower than that of the raw meat loaves for all levels of TSP substitution. In no case did the dieldrin content in the drip account for a significant loss in the pesticide content. In this current study the dieldrin was bound to some extent in the meat-loaf system. Starch is capable of binding pesticides; therefore, components such as the bread crumbs used in this study may be responsible for such binding. The use of increased levels of TSP results in less dieldrin being lost in the drip on cooking. However, other mechanisms such as codistillation appear to be significant in the reduction of dieldrin levels in this meat-loaf system. The degree of codistillation seems related to changes in moisture content and, thus, baking time and fat content of the meat loaves.

75-2597. Visweswariah, K.; Jayaram, M.; Majumder, S. K. (Cent. Food Technol. Res. Inst., Mysore, India). **Environmental pollution with pesticides.** *J. Food Sci. Technol. (Mysore)* 12(2): 53-60; 1975. (80 references)

In many instances the translocation of pesticides from the area where they were applied can be attributed to food or water as the transmission source. However, it is increasingly apparent that dispersion by air transport must also be considered. The main agents of pesticide contamination of the air are air-spraying operations. Air over both rural and urban communities contains pesticides, symptoms resulting from the drift of pesticides have been recorded 8-12 miles from the point of application, tracers used in air pollution studies have been found to drift as much as 22 miles, and many of the organochlorine pesticides have been detected in the rain water in several countries. Based on these data, it is hypothesized that pesticides can exist in the atmosphere, adsorbed on soil particles, and could be redeposited by rainfall washout on land areas remote from the site of original pesticide deposition. The pesticides can also enter the atmosphere by volatilization; the movement of unchanged DDT from treated crops and soil into the atmosphere has been suggested to contribute to the widespread environmental contamination by this substance. Although numerous studies relating to pesticide air pollution have been conducted in advanced countries, little is known of the magnitude of air pollution due to pesticide application in the developing and underdeveloped countries. Studies in these countries are urgently needed to protect the environment from these dangerous microchemicals.

75-2598. Deshmukh, S. M.; Joid, B. S. (Punjab Agric. Univ., Ludhiana, India). **Dimethoate residues on peaches.** *J. Food Sci. Technol. (Mysore)* 12(2): 92-94; 1975. (11 references)

Residues of dimethoate on peach fruits were estimated 0, 7, 14, and 20 days after spraying at concentrations of 0.025, 0.050, and 0.075% for the control of the peach fruit fly. The fruits were sprayed at the stage of maturity or at the full ripe stage. Residue levels were measured by gas-liquid chromatography using modified flame ionization and electron capture detectors. In most cases, the residue levels on the fruit were below the EPA tolerance limits of 2.0 ppm. The only exception was the 0 day samples taken after application of 0.075% dimethoate; even after application at this level, the residue levels on the fruit were within the tolerance limit 7 days after spraying. The residue levels in all cases diminished rapidly; however, the reduction was greater after spray application in June than after spraying in May.

75-2599. O'Loughlin, E. M.; Bowmer, K. H. (Commonwealth Sci. Ind. Res. Org., Div. Irrigation Res., Griffith, Australia). **Dilution and decay of aquatic herbicides in flowing channels.** *J. Hydrol.* 26(3/4): 217-235; 1975. (9 references)

The behavior of herbicides injected into flowing irrigation channels for aquatic weed control is analyzed. Such

herbicide movement is well represented by the one-dimensional model, so this work concentrated on relevant solutions to the one-dimensional convective-diffusion equation and the special features of these solutions most descriptive of herbicide behavior. Basic solutions are offered for instantaneous or continuous injections of material which decays at a first-order rate. Because herbicides are usually injected as step functions of limited duration, the general form of the solution to cover this case is presented. The important measures of herbicides' behavior, peak concentration and effective contact with the weeds, have been deduced from the analytical solutions, and the conditions under which a plateau in the concentration-time curve will exist have been defined. Dispersion coefficient, travel time, and decay rate constant are the 3 parameters which determine herbicide behavior. The latter can be highly variable under different environmental conditions. Methods for determining the rate constant have been derived and shown to yield simple expressions in terms of travel time and the observed concentration distributions. Field trials with the aquatic herbicide acrolein show great diversity exists in techniques of application and weed exposure. Decay rate constants under different conditions were in the range 0.14-0.2ℓ/hr. Opportunities exist for rationalizing the methods of application of this type of herbicide from viewpoints of both safety and economy.

75-2600. Beckmann, E. O.; Pestemer, W. (Institut fuer Nutzpflanzenforschung, Tech. Univ. Berlin, Germany). **Wirkung von unterschiedlicher Humusversorgung auf Herbicidabbau und biologische Aktivitaet des Bodens. [The effect of different organic manuring on herbicide decomposition and biological activity of the soil.]** *Landwirtschaftl. Forsch.* 28(1): 24-33; 1975. (14 references) (German)

The effect of mineral and organic fertilization on the degradation of linuron and on its effects on soil microbiological and biochemical processes was studied in carrot plots. Linuron was applied in spray form in doses of 1.5 and 3 kg/ha. After application of the 1.5 and 3 kg/ha doses, degradation rates of 30% and 37% were found after two weeks. The degradation rate reached 75% in 8 weeks. The residues in the soil ranged from 0.14 to 0.68 ppm at that time. Significant inhibition of the dehydrogenase activity of the soil by linuron was observed between 2 and 8 weeks after application. The inhibition was weaker in soils fertilized with organic and green manure than in the soils fertilized with synthetic fertilizers. Linuron also reduced the soil nitrogen content, especially in mineral fertilized soils.

75-2601. Ceurvels, A. R.; DerHovanesian, J., Jr.; Kaylor, J. (Massachusetts Div. Marine Fisheries, Cat Cove Marine Lab., Salem, MA 01970). **Ionizing radiation-induced changes in chlorinated hydrocarbons.** *Mar. Pollut. Bull.* 5(9): 143-144; 1974. (1 reference)

The effects of ionizing radiation on chlorinated hydrocarbon pesticide degradation were studied. Aldrin, dieldrin, heptachlor, lindane, and DDT were dissolved in hexane in concentrations of 0.2-1 ppm, after which they were exposed to 0.5-2.5 megarads of gamma radiation. Electron capture gas chromatography showed the presence of at least three breakdown products as indicated by new peaks. If these products represent less chlorinated derivatives of heptachlor, they are probably more readily biodegradable. In any case, the results confirm that high doses of gamma radiation induce the degradation of chlorinated hydrocarbon pesticides.

75-2602. Czyrnia, W.; Rother, B. (Inst. Pflanzenforsch. Kleinmachnow, Biol. Zentralanst. Berlin, Akad. Landwirtschaftswissenschaften der DDR). **Das Rueckstandsverhalten von 2,4-Dichlor-4'-nitrodiphenylaether im Boden und pflanzlichem Material. [Residues of 2,4-dichloro-4'-nitrodiphenyl ether in soil and in plant material.]** *Nachrichtenbl. Pflanzenschutzdienst DDR* 29(5): 112-115; 1975. (5 references) (German)

The residue behavior and migration of 2,4-D in soil and in cereal and vegetable plants were studied. Winter wheat, winter rye, and winter barley were treated with doses of 8-10 kg/ha, while cabbage, lettuce, and radishes were treated with doses of 5-25 liter/ha. Rapid decomposition of 2,4-D in the soil during the first 50-90 days was observed. The rate of decomposition decreased later, and concentrations of 0.4-1.5 ppm, corresponding to 10-38% of the initial concentration, were found after 8 months. Due to its low water-solubility, 2,4-D penetrates very slowly into the deeper layers of the soil. The penetrability increased in the order sand, loamy sand, and sandy loam. Residues of 2,4-D were detectable in only one grain sample, while two cabbage samples contained 0.02 and 0.08 ppm. Radish contained 0.07-0.14 ppm 2,4-D. The residue level was 0.01-0.045 ppm in lettuce. The residues were below the maximum allowable concentrations in all samples except lettuce and radishes.

75-2603. Chen, K. Y.; Lu, J. C. S. (Southern California Univ., Los Angeles 90007). **Marine studies of San Pedro Bay, California, VII. Sediment Compositions in Los Angeles-Long Beach Harbors and San Pedro Basin.** *Nat. Tech. Inform. Serv. COM* 74-11748, 191P, 1974. (111 references)

A large number of sediment analyses have shown the presence of pesticides, particularly organochlorines and organophosphates, in California coastal waters. It has been suggested that, once the pesticides are adsorbed by sediment particles, they are not released to the environment, so that the sediments in effect remove pesticides from natural waters. Undecomposed pesticides in sediments may still act as insecticides. The adsorption of some insecticides by bottom sediments is pH sensitive. Some are also salinity-dependent. The governing factors in pesticide adsorption by sediments are the pesticide concentration and the organic matter content of the sediment. Systematic studies of polychlorinated biphenyls in sediments

have only recently been carried out. Most surface sediments in the Los Angeles-Long Beach Harbors and nearby San Pedro Basin are grossly contaminated. Restricted dredging of polluted sediments is probably beneficial if the polluting substances can be properly disposed of.

75-2604. Smith, G. E. (Univ. Missouri, Dept. Agronomy, Columbia, MO 65201). **Losses of fertilizers and pesticides from claypan soils.** *Nat. Tech. Inform. Serv.* PB-239,831, 85p, 1974.

Nitrates, ammonia, phosphates, and pesticides were determined in the runoff and sediment under field conditions from a claypan, cornbelt soil. Samples for laboratory analyses were provided from 33 plots by individual storms during the 1971, 1972, and 1973 seasons. The soil is a claypan where the principal row crops are corn and soybeans. Chemical fertilizer additions were varied from amounts that were inadequate for satisfactory crop yields to quantities in excess of crop requirements. In the three growing seasons, precipitation varied from severe storms, with heavy runoff and soil loss, to conditions of moisture shortages where limited supplemental irrigation was applied to summer crops to reduce damage. Results of this study provide information under different seasonal practical methods of crop production. The data show the methods which can be employed to obtain optimum crop yields with the use of nitrogen and phosphorus fertilizers. The results point to methods that can minimize erosion and losses of nutrients in runoff.

75-2605. Hiramatsu, R.; Furuya, F. (Yamaguchi Prefect. Agric. Exp. Stn., Yamaguchi, Japan). [**Adhesion and residue of fenitrothion on fruits.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 80-81; 1975. (Japanese)

To elucidate the relationship between the morphology of fruits and the residues of pesticides applied to them, a 1000 fold diluted emulsion of 50% fenitrothion EC was sprayed on several trees at the rate of 400 ml/m^3 of crown. The pesticide residue on peel was determined by washing the fruits with acetone and injecting the acetonic solution into a FTD-GC to determine the residue. After washing with acetone, the pulp was homogenized, extracted with acetone, and the extract solution was transferred to acetone, then after cleaning up on an active carbon column the residue was determined by FTD-GC. It was found that the residue per unit surface area of fruit just after application became larger as the size of the fruit increased and showed species differences. It was further found that the residue in the pulp was smaller as the size of the fruit became smaller. The two kinds of residue showed a gradual decrease with time. The residue showed decreasing tendency in order of (elaeagnus, apple, grape), peach, (plum, loquat, sour plum).

75-2606. Ueda, T.; Otsuka, T.; Ishida, M.; Nakamura, T. (Pest. Res. Lab., Sankyo Co., Ltd., Tokyo, Japan). [**Persistence of isoxathion in soil.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 84-85; 1975. (Japanese)

Purified or technical isoxathion (*O,O*-diEt-*O*-(5-Ph-3 isoxazolyl) phosphorothioate) was mixed with various soils, and its persistence was assayed in laboratory and field. The residue was determined by extracting from the soil with acetone, transferring to *n*-hexane, and gas-liquid chromatography. Recovery was good, 87.5-98.5%, with the addition of 10 ppm; the minimum detectable amount was 0.1-0.2 ng. The half-life varied with the kind of soil, from 8 to 20 days in the field, and the 90% dissipation time also ranged from 40 to 90 days. According to the results of experiments carried out with other organophosphorus insecticides such as methylisoxathion, isoxathion seems to be a moderately persistent pesticide, with appropriate persistence in soil. In cabbage planted and grown in the isoxathion-treated soil the translocated amount of isoxathion was very small. It amounted to 0.010 ppm 8 days after application and less than 0.003 ppm after 29 days, when 50 mg of isoxathion was applied per plant 20 days after planting.

75-2607. Igarashi, H.; Uchiyama, M.; Sato, R. (Biochem. Lab., Central Inst. Nissan Chem. Co. Ltd., Shiraoka, Saitama, Japan). [**Studies on the metabolic degradation of pentachloronitrobenzene (PCNB). Part 3. Photodegradation of pentachlorothioanisole and pentrachloronitrobenzene.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 90-91; 1975. (Japanese)

Photodegradation of the major metabolites of PCNB in plants and soil, pentachlorothioanisole (PCTA) and pentachloraniline (PCA), was studied. The method comprised dissolving the respective compounds in hexane (at 50 ppm), irradiating with light from a sterilizing lamp, and injecting onto a GC at intervals. After irradition of PCTA for 72 hr, 1,2,3,5-, 1,2,4,5- and 1,2,3,4-tetrachlorobenzene and pentachlorobenzene were identified, as well as tetrachlorothioanisole (presumed). As PCTA decreased, the pentachlorobenzene content increased. Pentachloroaniline was quite stable upon irradiation under UV for 100 hr.

75-2608. Fujimura, N.; Wada, Y. (Pesticides Laboratory, Nippon Tokushu Noyaku Seizo Co., Ltd., Hino, Tokyo, Japan). [**Behavior of EDDP, *O*-Ethyl *S,S*-diphenyldithiophosphate, in a nitrogen atmosphere at high temperatures.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 101-102; 1975.

EDDP, *O*-ethyl *S,S*-diphenyldithiophosphate (edifenphos, a pesticide against rice blast), was subjected to thermal gravimetric analysis and differential thermal analysis to determine its stability. Pure EDDP was thermally decomposed in a nitrogen atmosphere; the decomposition products were caught in a cold trap with liquid air, and the products were determined by GC. Direct identification of decomposition products was also carried out by heat-decomposition GC. A weight decrease was noted,

beginning at 130°C, with vaporization of a non-phosphorus compound; free radical exothermic decomposition was noted at 246°C. The thermal decomposition products identified were CO, carbon dioxide, hydrogen sulfide, carbon disulfide, diethyl thioether, thiophenol, ethyl phenyl thioether, diphenyl sulfide, diphenyl disulfide, *O,O*-diethyl *S*-phenyl phosphorothioate, and tri(phenylthio) phosphate.

75-2699. Valange, B. (Cent. Etude Pestic. Agric. Stn., Phytopharm. Etat, Gembloux, Belgium). **Les residus de pesticides dans les fruits et legumes. Resultats d'une enquete effectuee en 1972. [Pesticide residues in fruits and vegetables. Results of a survey performed in 1972.]** *Parasitica* 30(1): 13-21; 1974. (French)

Results of pesticide residue analysis carried out on lettuce, romaine lettuce, strawberries, raspberries, apples, celery, pears, and fodder pellets in Belgium in 1972 are presented. Residue levels in excess of the respective tolerance limits were found in less than 8% of the 700 samples. It was possible to reduce the very high thiram residues in lettuce to below the maximum allowable level of 3 ppm by removing the two or three outer leaves, as most of the residue was concentrated in these levels. The benomyl residues were below 0.01 ppm in 57 of 103 strawberry samples, and over 1 ppm in 16 samples. The thiophanate levels were below 0.01 ppm in 7 of 48 samples, and over 1 ppm in 16 samples. The thiram and captafol residues combined were below 3 ppm. The tecnazene residue was below 0.01 ppm in 52 of 54 samples of romaine lettuce, while the quintozene level exceeded the tolerance in 4 samples. Traces of DDD (TDE), DDE, aldrin, endosulfan, and DDT residues below 0.4 ppm were found in apples and pears. Unlike the lindane residues, the aldrin and *p,p'*-DDT residues exceeded the maximum allowable concentrations in a few of the fodder pellet samples investigated.

75-2610. Fraselle, J. (Fac. Sci., Agron, Etat, Gembloux, Belgium). **Etude de diverses modalites de traitement contre les maladies des parties aeriennes de l'escourgeon. Resultats des essais en reseau realises en 1974. [A comparison of different sequences of fungicide applications on winter barley. Results of large-scale testing completed in 1974.]** *Parasitica* 30(4): 167-180; 1974. (French)

The efficiency and profitability of different modalities of fungicide treatment in winter barley and the fungicide residue in grains were studied under field conditions. One application at the awn emergence stage proved to be most profitable and also resulted in the lowest fungicide residue level. The maneb residues after application of a dose of 1.4 kg/ha ranged from 0.07 to 1 ppm, and such residues were not detectable in many samples. The propineb residues were in a range of 0.01-0.3 ppm, while zineb was not detectable. The tridemorph residue levels reached up to 0.05 ppm. Benomyl was found in concentrations of 0.06-0.16 ppm in certain samples without being detectable in most samples. Methylthiophanate levels ranged from 0.05 to 0.15 ppm.

75-2611. Henriet, J. (Stn. Phytopharm. Etat, Gembloux, Belgium). **La pollution de l'environment par les pesticides. [Environmental pollution by pesticides.]** *Parasitica* 30(1): 5-12; 1974. (French)

General problems of environmental pollution by pesticides and hygienic implications of pesticide residues are discussed. Persistent persticides, such as organochlorine preparations, may accumulate through the trophic chains. Atmospheric air usually contains organochlorine pesticides in a concentration of 1 μg/1,000 m^3, but peaks up to 20 μg/m^3 may occur in village during pesticide application. River water and precipitation contains 0.1 mg organochlorine pesticides per m^3. Sea water generally contains 0.02 mg/m^3 *p,p'*-DDT, 0.003 mg/m^3 DDE, 0.003 mg/m^3 dieldrin, and 0.1 mg/m^3 PCBs. Suspended matter in river water has a pesticide load of 0.1 mg/m^3, while benthic sediments accumulate such residues by factors of 100 to 10,000. Ocean fish contain 0.03 ppm *p,p'*-DDT, 0.005 ppm DDE, 0.002 ppm DDD (TDE), 0.006 ppm lindane, 0.01 ppm dieldrin, and 0.3 ppm PCBs. The amount of organochlorine pesticides inhaled may account for up to 50% of the acceptable daily intake, and that ingested with water may account for 0.1 to 10% of the acceptable daily intake, depending on the degree of water pollution. In general, there are no real dangers presently in connection with the ingestion of DDT. However, the long-term accumulation and long-term effects of pesticides in humans are largely unknown.

75-2612. Harper, D. B.; Balnave, D. (Dep. Agric. Food Chem., Queens's Univ., Belfast, N. Ireland). **Chloroanisole residues in broiler tissues.** *Pestic. Sci.* 6(2): 159-163; 1975. (5 references)

The relative tissue concentrations and total bird levels of chloroanisoles in commercial broilers reared on litter are reported. The levels observed at either 4 or 8 weeks of age are well below those quoted as inducing taint development in cooked birds. Although the highest concentrations of chloroanisoles occurred in bone and adipose fat, the greatest contribution of chloroanisoles to "whole bird" levels was found in edible tissue. However, this was predominantly pentachloroanisole which is unlikely to cause a taint problem since it has a much higher taint threshold than tetrachloroanisole. (Author abstract by permission)

75-2613. Opekar, B.; Hruska, J.; Kocianova, M. (Natl. Inst. Hyg., Ceske Budejovice, Czechoslovakia). **Zjistovani expozice pracovniku pri aplikaci insekticidnich preparatu typu chlorovanych uhlovodiku v zemedelstvi. [Determination of the exposure of workers during application of chlorinated hydrocarbon insecticides in agriculture.]** *Prac. Lek.* 26(9): 339-343; 1974. (21 references) (Czech)

Hazards to workers applying DDT and HCH (BHC) in disinsection of fields against gnats were studied. Chlorinated hydrocarbon insecticide (CHI) concentrations were measured by means of gas chromatography in the brea-

thing area while CHI levels in the workers' blood were ascertained simultaneously. Except for short, isolated periods, CHI concentrations in the breathing area and the total inspired amounts for all workers were very low. After work using thermal mists CHI levels in blood doubled. After spraying they remained unchanged. Thus working with thermal aerosols produces a greater health hazard. Higher CHI blood levels were experienced in occupationally exposed workers than in the control group, suggesting a higher accumulation of CHI in their bodies. Experiments were undertaken on the influence of peroral CHI intake via food upon short-term fluctuation of blood CHI levels.

75-2614. Geisman, J. R. (Dep. Horticult., Ohio State Univ., Columbus, OH 43210). **Reduction of pesticide residues in food crops by processing.** *Residue Rev.* 54: 43-54; 1975. (37 references)

An adequate and safe food supply has highly emotional implications to society. Unit operations normally employed in processing food crops reduce or remove pesticide residues, if present. The washing operation has been studied in-depth with specific recommendations derived for many commodities. Other unit operations such as peeling, blanching, and cooking play a role in reducing residues. Each operation has a cumulative effect on the reduction of pesticides present. Refinements of existing operations and newly devised operations should be evaluated for efficiency in removing residues. The consumer can contribute to the reduction of residues by home preparative methods. Most commodities can be washed at home and proper cooking destroys many residues. It would seem beneficial to include this information in consumer education programs. (Author abstract by permission)

75-2615. Usuya, S.; Nishiyama, K. (Sch. Public Health, Fac. Med., Hirosaki Univ. Hirosaki, Aomori, Japan). [**Amount and significance of pesticide inhaled during application.**] *Sangyo Igaku (Jpn. J. Ind. Med.)* 17(3): 175-176; 1975. (Japanese)

There are several problems involved with methods of determining the amount of pesticide inhaled by the applicator while he is applying the pesticide. Methods include direct ones, i.e., catching the pesticide with an impinger or filter pad; and indirect ones, e.g., determining the amount of pesticide metabolites in the urine of the applicator. The direct method was discussed, based on the author's experimental results and descriptions in the literature. With an impinger the amount ranged from zero to 390 mg/m^3, and with a filter pad the amount ranged from less than 0.01 to 1.27 mg/hr with fairly large fluctuations in results between test subjects. Several factors accounting for differences between test subjects and even between results obtained at various times for one person were considered, such as the physical properties of the pesticide formulation, method and apparatus used for application, and direction and strength of wind during application.

75-2616. Miki, T. (Jpn. Sug. Refiners' Assoc., Tokyo, Japan). [**PCBs and organochlorine pesticide residues in sugars.**] *Seito Gijutsu Kenkyu Kaishi (Proc. Res. Soc. Jpn. Sug. Refineries' Technol.)* 25: 32-38; 1975. (Japanese)

Refined sugars, liquid sugars, refinery molasses, and raw sugars were analyzed for PCB (polychlorinated biphenyl) content by gas chromatography. Organochlorine pesticide residues (α-, β-, γ-, and δ-BHC; p,p'-DDT; p,p'-DDE; dieldrin) in raw sugars were also analyzed by this method. PCBs were not found in 35 samples of refined sugars and 6 samples of liquid sugars. Very low PCB levels (below 0.03 ppm) were detected in 3 of 20 raw sugar samples and 3 of 5 molasses samples. Analysis of organochlorine pesticide residues in 18 raw sugars revealed a relatively high peak of γ-BHC (lindane) on the chromatograms; the total BHC content is less than 0.0063 ppm. A few samples revealed minimal amounts of DDT and DDE.

75-2617. Simsiman, G. V.; Chesters, G. (Dep. Soil Sci., Univ. Wisconsin, Madison, WI 53706). **Persistence of endothall in the aquatic environment.** *Water Air Soil Pollut.* 4(3/4): 399-413; 1975. (27 references)

The factors governing the persistence of endothall in the aquatic environment were investigated in a simulated lake impoundment and a closed sediment-water incubater system. In the simulated lake impoundment 72% of added endothall persisted in water for 30 days due to prolonged dissolved oxygen depletion following weedkill during this period. Rapid disappearance of endothall occurred only after the restoration of oxygenated and oxidizing conditions. Under these conditions little or no endothall was detectable after 60 days. Degradation of endothall was slow in weed free and quiescent sediment water systems containing abundantly overlying water, even under aerobic condition. The slowness of degradation was evidenced by the small amount of $^{14}CO_2$ evolution and the persistence of intact endothall in the water after 2 mo. Reducing the water volume 10 fold (5 ml sediment:20 ml water) resulted in a 25 fold increase in the degradation of endothall in the Lake Mendota but not the Lake Tomahawk system. The significantly higher adsorptive capacity of Lake Tomahawk sediment for endothall could be attributed to its higher organic matter and amorphous mineral contents and lower pH than the Lake Mendota sediment. The extent of adsorption of acidic herbicides to organic colloids and amorphous minerals appears to be inversely related to pH.

75-2618. Weber, J. B.; Weed, S. B.; Waldrep, T. W. (North Carolina State Univ., Raleigh, NC). **Effect of soil constituents on herbicide activity in modified-soil field plots.** *Weed Sci.* 22(5): 454-459; 1974. (14 references)

An organic muck and a montmorillonite clay were incorporated into the surface 7.6 cm of a structureless sandy soil at rates ranging from 26,880 to 89,600 kg/ha.

Prometryne (2,4-bis(isopropylamino)-6-(methylthio)-*s*-triazine) and fluometuron (1,1-dimethyl-3-(*a*,*a*,*a*-trifluoro-2,6-dinitro-*N*,*N*-dipropyl-*p*-toluidine) were incorporated at two rates each in 1968, 1969, and 1970. Organic matter greatly reduced the biological activity of all three herbicides. Montmorillonite clay greatly reduced the activity of prometryne, slightly decreased the activity of fluometuron, and had no significant effect on trifluralin activity in all but the first year of the study. Both soil additives increased the cation exchange capacity of the soil. Muck decreased soil pH while montmorillonite increased it. (Author abstract by permission)

75-2619. Zamfir, G.; Apostol, S. (Inst. Hyg., Acad. Med., Jassy, Rumania). **Zur Problematik der Wirkung einiger Pestizide auf die hygienisch-sanitaeren Indikatoren des Wassers. [The problem of the effect of some pesticides on the hygienic and sanitarian indicators of water.]** *Z. Gesamte Hyg. Ihre Grenzgeb.* 20(11): 777-781; 1974. (15 references) (German)

A complex study is described of the hygienic and sanitary effects of certain pesticides in water and of their biochemical effects in warm-blooded animals. Lindane, 2,4-D, DDT, dibutox, and DNOC were found to impair the organoleptic properties of water and to cause discoloration and opalescence even when present in trace concentrations below 1 mg/l. Dibutox was persistent in water for over 5 months, DDT for over 4 months, lindane for over 131 days, and ethanolamine for well over 20 days. Increase in the oxidizability of water, changes in the nitrogen content, and increased BOD5 values were measured in water in the presence of pesticides. The pesticides promoted the growth of bacteria, including colibacteria, Enterococci, and bacteriophages of *Bact. coli* and *Bact. typhi* unless they were present in very high concentration. Lindane, DDT, and their mixtures inhibited planktons in concentrations as low as 0.02 mg/l. Dipterex, DDT, and dibutox were most toxic for *Daphnia magna* Strauss. Tetradifon administered to albino rats in a dose of 20 mg/100 g increased the aldolase, transaminase, phosphatase, cytochrome oxidase, and succinate dehydrogenase activities.

75-2620. Laveglia, J. G. (Iowa State Univ., Ames, IA). **Interaction of three Iowa surface soils with the organophosphorus insecticide Counter.** *Diss. Abstr. Int.* 36(2): 566B; 1975.

The insecticide Counter (terbufos) was applied to 10 g samples of 3 Iowa surface soils at rates of 1-100 ppm; 1 ppm corresponds to a field application rate of 1 lb/acre. Soil samples were incubated at 22°C for up to 6 weeks; microbial activities were measured via ammonium production, nitrification, carbon dioxide evolution, sulfur oxidation, and cellulose decomposition. Statistical analysis revealed no significant deviations from findings in control soils. Counter added to the three soils at 1 ppm and incubated at 22°C was rapidly oxidized to its sulfoxide. The parent compound had an approximate half-life of 4-5 days. Counter sulfoxide reached a peak after 2 weeks of incubation, while Counter sulfone did not appear until 1 week after the incubation was started. Significant differences were found in the abilities of the three soils to degrade Counter. Counter sulfoxide and Counter sulfone had no inhibitory influence on soil microbial activities. (Author abstract by permission, abridged. Copies of the thesis are available from University Microfilms, Order No. 75-17,397.)

75-2621. Mullendore, G. P. (Mississippi State Univ., University, MS). **Herbicide residue studies with different management regimes of cotton production and cover crops.** *Diss. Abstr. Int.* 36(3): 1006B; 1975.

When cotton was grown using recommended preemergence herbicides at 1.12, 2.24, and 4.48 kg/ha, cotton yield and fiber quality were not reduced, although plants were stunted. Crimson clover was more difficult to produce following cotton than was hairy vetch, although both were inhibited at higher herbicide application rates. No differences existed in the rate of degradation of herbicides with cover crops except at the 4.4 kg/ha rate of diuron. Faster degradation occurred where hairy vetch was grown than with no cover crop or crimson clover. Fluometuron degraded more rapidly than diuron. Residues tended to be lower where hairy vetch was produced than in the other areas. Cucumbers planted in prepared seedbeds after cover crop incorporation substantiated this trend. The production and incorporation of a cover crop appeared to be feasible and beneficial following herbicides used in cover crop production. (Author abstract by permission, abridged. Copies of the thesis are available from University Microfilms, Order No. 75-20,729).

75-2622. Ladlie, J. S. (Michigan State Univ., East Lansing, MI). **Effect of soil pH on metribuzin (4-amino -6- *tert*-butyl -3- (methylthio) -1,2,4- triazin-5(4H)one) activity and fate in soil.** *Diss. Abstr. Int.* 36(3): 1015B; 1975.

Metribuzin [4-amino -6- *tert*-butyl -3- (methylthio)-1,2,4- triazin-5(4H one] activity in the field increased with increasing soil pH. Fall panicum (*Panicum dichototomiflorum* Michx.) control, number of dead corn (*Zea mays* L.) and soybean (*Glycine max* (L.) Mer.) plants, and crop injury ratings increased, whereas plant height and grain yield decreased as soil pH increased. Metribuzin residue analysis of soil samples showed greater amounts of residue extractable at soil pH 6.7 than 4.6. Metribuzin leaching increased with increasing soil pH in the field. Metribuzin disappearance from soil followed pseudo first-order kinetics. Rate constants increased and the half life of metribuzin decreased as soil pH increased. Rate constants decreased and the half life of metribuzin increased at all soil pH levels as depth of sampling decreased. Metribuzin phytotoxicity to corn and soybeans grown in the

greenhouse increased with increasing soil pH. Microbial degradation decreased as the soil became more acid. Metribuzin and atrazine [2-chloro-4- (ethylamino) -6-(isopropylamino) -*s*- triazine] mobility increased with increasing concentration and soil pH. ^{14}C-metribuzin had greater mobility on soil thin-layer plates than ^{14}C-atrazine because of differences in water solubility and basicity. The pKa of metribuzin was determined to be 0.99 ± 0.08. Adsorption increased gradually as the soil pH decreased toward the pKa of metribuzin. Protonation of the amine group with subsequent absorption to soil colloids was postulated to be the reason for the reduction in phytotoxicity, microbial degradation, and mobility of metribuzin in acid soils. (Author abstract by permission. Copies of the thesis are availaable from University Microfilms, Order No. 75-20,855.)

75-2623. Estep, C. B. (Univ. Tennessee, Knoxville, TN). **A study of chlorinated hydrocarbon insecticide residues in Tennessee honey and beeswax.** *Diss. Abstr. Int.* 36(3): 1056B; 1975.

Whether Tennessee honey and beeswax cappings contained chlorinated hydrocarbon insecticides (CHI) was determined. The samples were assayed for those CHI most often found in human tissue and those most persistent in the environment. Honey samples were assayed by gas chromatography (GLC) with an electron capture detector (EC). In the sample preparation prior to GLC, the cleanup procedure utilized a one-percent v/v ether-hexane eluting solution for a 6 cm × 15 mm Florisil column. A new method of sample preparation for the analysis of beeswax by GLC with EC was developed. This method consisted of using chilled solvents and a chilled 6 cm × 15 mm Florisil column with a one-percent v/v ether-hexane eluting solution. Twenty-eight of the thirty samples of honey analyzed contained CHI in the low parts per billion range. Two honey samples showed no detectable CHI. Nineteen samples of beeswax cappings contained CHI at the ppb level and one beeswax sample revealed no detectable CHI. The number and quantity of CHI in beeswax were considerably greatly than in honey. (Author abstract by permission. Copies of the thesis are available from University Microfilms, Order No. 75-18,957.)

75-2624. Pape, B. E. (Michigan State Univ., East Lansing, MI). **Photochemistry of bioactive compounds. I. Solution-phase photochemistry of asymmetric triazine-5-(4H)-ones. II. Solution-phase photochemistry of symmetrical triazines.** *Diss. Abstr. Int.* 36(3): 1058B; 1975.

The photolysis of 4-amino-6-R-3 -(methylthio) -*as*-triazine -5-(4H)-ones (R = cyclohexyl, *t*-butyl, isopropyl) in carbon tetrachloride, benzene, methanol, water, or in the crystalline state yields the respective 5-hydroxy-6-R-(methylthio)-1,2,4-triazine as the major product. Minor reactions proceed by routes which include desulfurization and oxidation. Reaction mechanisms are considered. Photolysis of 2-fluoro and 2-bromo-4,6-bis(ethylamino)-*s*-triazine in methanol and water at 253.7 and 300 nm yielded the 2-methyl and 2-hydroxy analogs as the major products. Photolysis of the 2-iodo-*s*-triazine analogs of atrazine, propazine, and simazine in methanol, ethanol, and *n*-butanol at 300-360 nm yielded the respective 2-alkoxy and 2-hydroxy compounds as the major product(s). Reaction mechanisms are considered. Consideration of thermal, photochemical, and spectroscopic data are suggestive of the participation of a Chugaev-type cyclic transition state in the photochemical dealkylation of *s*-triazines. Photolysis of 2-azido -4-ethylamino -6-methylthio -*s*-triazine in methanol at 253.7 and 300 nm yielded 2-amino -4-ethylamino -6-methylthio-*s*-triazine, 2-amino-4-ethylamino-*s*-triazine, and 2-azido-4-ethylamino-*s*-triazine. The observation of a "sensitized" photodecomposition of 4,6-bis(isopropylamino)-*s*-triazine is reported. (Author abstract by permission. Copies of the thesis are available from University Microfilms, Order No. 75-20,878.)

See also 75-2563 75-2564 75-2635 75-2760

75-2625. Winell, M. A. (Sect. Occup. Toxicol., Natl. Board Occup. Safety Health, Fack, Stockholm, Sweden). **An international comparison of hygienic standards for chemicals in the work environment.** *Ambio* 4(1): 34-36; 1975. (6 references)

To control occupational exposure to airborne particulates, gases, and vapors, hygienic standards for the work environment are in force in several countries. The U.S. and Soviet standards include 169 mutual substances, which are listed. With each substance are listed the hygienic standards in the U.S., U.S.S.R., East and West Germany, Sweden, and Czechoslovakia. Wide discrepancies exist between the hygienic standards in different countries; the variations are smaller with the primarily irritating substances, metals, and metalloids. In general, the U.S. standards are the highest and the Soviet standards are the lowest. Among the substances listed are arsenic and arsenic compounds, carbaryl, 2,4-D, DDT, dichlorvos, dieldrin, heptachlor, and lindane.

75-2626. Ramanathan, N. L.; Kashyap, S. (Natl. Inst. Occupational Health, Ahmedabad, India). **Occupational environment and health in India.** *Ambio* 4(1): 60-65; 1975. (11 references)

Comparative problems posed by the working environments in developing and developed countries are discussed. Among the epidemiological parameters which might affect the occupational health problems encountered in countries of different socioeconomic status are differing work practices, variations in hygienic practices, and/or varying climate conditions. Profound differences in the nature of the exposed workers could also exist between developing and developed countries. These differences could be genetic, physiological and psychological, nutritional, economic and educational, and/or cultural and social. Within this framework, occupational health problems affecting agricultural and industrial workers in developing and developed nations are considered. Agricultural workers are affected by the increasing use of agricultural chemicals, particularly pesticides. Although the pesticide consumption in India is less than in the advanced countries, the pesticide residue levels in the Indian population are by far the highest in the world. Local factors such as genetic and nutritional variations and the lack of personal hygiene among Indian agricultural workers appear to contribute to this finding. The problem of pesticide poisoning in India has not been the object of much systematic research and only recently has received adequate priority.

75-2627. Gervais, P.; Langevin, M. T.; Gaultier, M.; Housset, M.; Boucker, M.; Mazurkiewicz, S. (Hopital Fernand-Vidal, Paris, France). **Normalisation des cholinesterases chez des ouvriers desinsectiseurs par les methodes modernes de prevention. Consequences reglementaires possibles. [Normalization of cholinesterase in pest control workers by modern methods of prevention. Possible regulatory consequences.]** *Arch. Mal. Prof. Med. Trav. Secur. Soc.* 35(9): 789-796; 1974. (5 references) (French)

Cholinesterase activities were determined in 11 pest control workers permanently exposed to organophosphorus pesticides in open air or in limited interior space, and an improved application method is proposed. Three workers showing no symptoms of poisoning had abnormally low acetylcholinesterase, erythrocyte, and plasma cholinesterase levels. The new regulations introduced concerning the handling and application of organophosphorus pesticides require the use of extensive skin protection, the use of shower, and separate storage of work clothes from regular ones. Also, eating, drinking, and smoking during work is prohibited. The exposure to high concentrations is limited by employing the workers alternately in indoor and outdoor jobs. Normalization of the biochemical parameters was observed after the implementation of these working conditions.

75-2628. Botta, A. (Author address not given). **Les organophosphores. [Organophosphorus pesticides.]** *Arch. Mal. Prof. Med. Trav. Secur. Soc.* 35(10-11): 929-932; 1974. (French)

The metabolism and mode of action of parathion and other organophosphorus pesticides and symptoms provoked are discussed with particular reference to occupational safety. Parathion undergoes either detoxifying enzymatic hydroxylation or oxidative metabolism with paraoxon, a more toxic compound, as an intermediary. Parathion and related organophosphorus pesticides cause specific inhibition of the cholinesterase activities, thereby inducing parasympathomimetic symptoms, miosis, acceleration of the intestinal peristalsis, bronchial constriction, and hypersecretion, depending on the degree of inhibition. While parathion is highly toxic, it is metabolized in a few days and eliminated with urine after prolonged intake of small quantities. A reduction of the cholinesterase activity by organophosphorus compounds is not necessarily accompanied by poisoning symptoms, which indicates the high sensitivity of this enzyme.

75-2629. Ely, B. (19, Rue Ste. Catherine, 84000 Avignon, France). **Surveillance biologique d'utilisateurs d'organo-phosphores. [Biological supervision of utilizers of organophosphates.]** *Arch. Mal. Prof. Med. Trav. Secur. Soc.* 35(12): 963-970; 1974. (3 references) (French)

Biochemical tests performed in farm workers occupationally exposed to organophosphorus pesticides and in a non-exposed control population are described. The urinary paranitrophenol level were above 400 μg/l in 7 of 53 cases, reaching values up to 2,000 μg/l. No correlation was established between the urinary paranitrophenol level and the erythrocyte cholinesterase level. The erythrocyte cholinesterase levels showed seasonal variations in both the exposed and non-exposed groups with a minimum during the April-August period. The cholinesterase levels were lowest in the exposed farm workers. It was not possible to establish the cause of the seasonal variation. The cholinesterase level was found to correlate with age, glycemia, cholesterol, and with the Burstein test.

75-2630. Taneda, M.; Hara, T. (Kitazato Univ., Sch. Med., Sagamihara, Japan). **Narcoleptic-like symptoms in organophosphorus poisoning, a case report.** *No to Shinkei (Brain Nerve)* 27(2): 211-218; 1975. (22 references)

A 47 yr old female was examined by a pyschiatrist in connection with a court committment for reason of kleptomanic behavior. Her condition was diagnosed as narcolepsy because of her complaints of drowsiness, weakness in the upper and/or lower limbs and some autonomic symptoms. At the time of this examination she did not inform the doctor that she had taken parathion 12 yr earlier in a suicide attempt. Since that time antinarcoleptic drugs had been prescribed by several doctors with no improvement in either symptoms or the kleptomania. Gas chromatography revealed 0.07 ppm parathion and 2.02 ppm dichlorvos in her blood. Precise observations of her actions in the ward revealed that her complaints were different from typical symptoms of narcolepsy. Moreover, analysis of all-night EEG records showed shortening of latency for the first REM sleep and disorganization of REM and NREM sleep in the early morning sleep period. Earlier studies reported that there are two types of drowsiness as sequelae of this poisoning. First, a nearly narcoleptic type, falling into REM sleep directly from stage 1 or 2 of sleep. In this first type, clinical symptoms are hardly improved. In the second type, excessive drowsiness occurs, and the case is less serious. Remissions and relapses of the symptoms can be observed for several years in type 2 patients. It is concluded that the patient presented here is of type 2.

75-2631. Anonymous. **Precautions for pesticide fires.** *Fire Eng.* 128(3): 24-26,28; 1975.

The risk of breathing toxic fumes, mists, or dusts from pesticides is a very real problem for those fighting a pesticides fire. A self-containing breathing apparatus must be used. Other hazards encountered in a pesticide fire include chemicals used as solvents or propellants, aerosol cans, contaminated runoff water, and water-damaged pesticides. Some of the solvents used with pesticides are highly flammable or explosive. Fire fighters should avoid breaking bags raising dust at a place where pesticides are stored. Finely divided dusts can ignite easily. Oxidizing agents may be present. If ammonium nitrate fertilizer is improperly stored near fats, oils, acids, finely divided metals, sulfur, etc., it becomes highly sensitized, flammable, and explosive. The large amounts of oxygen given off when this fertilizer burns increase the intensity of the fire. Toxic gases are released during its burning. Herbicides containing chlorates may be flammable or explosive. Poisoning symptoms can be mistaken for smoke inhalation difficulties, and therefore proper treatment may be delayed. Water runoff from a pesticide fire must be kept from streams, lakes, or sanitary sewers as it may contain concentrations of pesticides which can cause lasting environmental damage. Foam should be used whenever possible to reduce toxic runoff. General symptoms associated with pesticide poisoning are headache, giddiness, nausea, blurred vision, and chest pains. Advanced, sure signs of poisoning include sweating, pinpoint pupils, drooling, and vomiting. During a pesticide fire, care must be taken to protect fire fighters, safeguard the public, fight the fire, and neutralize toxic wastes.

75-2632. Kono, K.; Ishikawa, S.; Uga, S. (Sch. Ophthalmol., Kitasato Univ., Sagamihara, Kanagawa, Japan). [**Impairment of optic nerve and peripheral nerve in chronic organophosphorus intoxication.**] *Ganka Rinsho Iho (Jpn. J. Clin. Ophthalmol.)* 69(8): 969-971; 1975. (3 references) (Japanese)

Six month old beagles, body weights 5 to 9.4 kg, were administered ethyl thiometon at 5, 10, or 15 mg/dog daily for 2 years and examined histopathologically. In the optic nerve, the loss of medullated nerve fiber by denaturation of the axon and increase in the follicles of astrocyte and in septa of the fiber bundles with extuberances at the center were conspicuous. A dose-response relationship was observed with respect to the ratio of medullated nerve fibers. The findings were confirmed electron microscopically. In calf nerve, decrease in fibers of small diameter and hypertrophy of atrophic medullar sheaths in the axon of medullated nerve fibers with larger diameter were observed. Change in the motor nerve system were very slight. The above findings pointed out the predominance of sensory neuropathy in chronic organophosphorus intoxication in mammals.

75-2633. Fujii, T.; Ishikawa, S.; Tokumasu, K.; Kawano, R.; Ozawa, H. (Sch. Ophthalmol., Kitasato Univ., Sagamihara, Kanagawa, Japan). [**Results of examination of equilibrating function in patients with chronic organophosphorus intoxication.**] *Ganka Rinsho Iho (Jpn. J. Clin. Ophthalmol.)* 69(8): 1055-1056; 1975. (Japanese)

Examinations of equilibrating function were carried out in 5 patients following contact with organophosphorus compounds. These patients had residual organophosphorate levels in blood of over 0.01 ppm, reduced ChE activity, and disturbance of visual acuity except in one case, complicated by nervous symptoms. Almost all cases showed visual field stenosis, reduction of sensitivity at 656 nm in Tubinger test, increase of deep tendon reflex on knee jerk, and decreases in conduction velocity of sensory nerves in the limbs. Some cases showed abnormal following motion of the eye-balls and abnormal OKP test and PRT. These and other findings pointed out some disturbances of vestibular function due to chronic intoxication by organophosphorus compounds.

75-2634. Ozawa, H.; Usui, N.; Hirasawa, Y.; Obayashi, M.; Ishikawa, S. (Faculty of Culture, Shizuoka Univ., Shizuoka, Japan). [**Equilibrating function and eye-ball motion determined by a newly developed gravicorder.**] *Ganka Rinshi Iho (Jpn. J. Clin. Ophthalmol.)* 69(8): 1057-1059; 1975. (Japanese)

Quantitative analytical data on the effect of stimulation input on the center of gravity was described. Data was obtained on patients suffering from chronic organophosphorus intoxication using a newly developed gravicorder invented by the authors. The findings on the spike interval, the average value of the amplitude of oscillation in the center of gravity, and its standard deviation with eyes open and shut pointed out a possible disturbance of the equilibrating nerve center.

75-2635. Seibel, W. (Author address not given). **Die Muellerei, ein umweltfreundliches Produktionsverfahren. [Milling, a production process friendly to the environment.]** *Getreide Mehl Brot* 28(3): 64-68; 1974. (24 references) (German)

Problems of residues of pesticides, heavy metals, radioactive contaminants, and aflatoxins in bread-grain and bakery products are discussed, as well as the fate of such residues during milling. The maximum allowable concentrations of hydrocyanic acid, lindane, malathion, methylbromide, hydrogen phosphide, piperonyl butoxide, pyrethrins, and dichlorvos in bread-grain in West Germany are 15 ppm, 0.1 ppm, 3 ppm, 50 ppm, 0.1 ppm, 10 ppm, 3 ppm, and 2 ppm, respectively. The corresponding limits for bakery products are 6 ppm, 0.01 ppm, 0.3 ppm, 50 ppm, 0.01 ppm, 1 ppm, 0.3 ppm, and 0.5 ppm. The mercury and cadmium residues are limited to 0.05 ppm, and 0.01 ppm in bread-grains and bakery products alike. Lindane and DDT have been replaced by gaseous products. Milling results in a reduction of the contaminant concentrations in flour, and in a corresponding accumulation in brans.

75-2636. Mullner, R. M. (Chicago State Univ., Chicago, IL). **Seasonal variations of accidental poisoning in children: Illinois, 1972-73.** *Ill. Med. J.* 148(2): 139-140; 1975. (5 references)

Seasonal variations were determined of accidental poisoning in children in Illinois during 1972-73. Approximately 17,000 children under 13 yr of age were reported to have ingested some type of poisonous substances, and 37 children died from accidental poisoning during that period. Of the ten poison types, internal medicines are the most predominant type of poison ingested in the state, accounting for 8482 cases (56.4%). The next most important poison type is household preparations which account for 2289 poison cases (15.3%). These two types are followed by pesticides (152 cases, 6.3%); external medicines (848 cases, 5.6%); paints, varnishes, lacquers, solvents (839 cases 5.6%); petroleum distillates (697 cases, 4.6%); and cosmetics (621 cases, 4.1%). Plants account for 228 cases (1.5%) and gases and vapors and veterinary products account for 52 and 47 cases (0.3% and 0.3%), respectively. Three poison types were identified as having a marked seasonal pattern: internal medicines, petroleum distillates, and plants.

75-2637. Gupta, P. C. (Dep. Neurol., All-India Inst. Med. Sci., New Delhi, India). **Neurotoxicity of chronic chlorinated hydrocarbon insecticide poisoning—a clinical and electroencephalographic study in man.** *Indian J. Med. Res.* 63(4): 601-606; 1975. (13 references)

Twelve cases of neurotoxicity resulting from the repeated consumption of wheat contaminated with aldrin dust and gamaxin powder (BHC) are reported. The patients consumed this wheat for 6-12 mo before showing clinical symptoms, which consisted of myoclonic jerks, generalized tonic clonic convulsions, loss of consciousness, weakness in the extremities, flashes of light and color, and noises in the ears. Electroencephalographic studies in six cases showed excess slow waves, spike activity, and paroxysmal delta wave bursts of short duration. Two dogs, two bullocks, and a buffalo were also affected, with generalized seizures and myoclonic jerks. In the human patients, both the clinical and EEG features were reversible with drug treatment. Diazepam was more effective than phenobarbiton and phenytoin sod in controlling the myoclonic jerks and other minor seizure phenomena. The need for educating Indian farmers regarding the proper handling of pesticides is emphasized.

75-2638. Gerdts, E. (Komediebakken 11, 5000 Bergen, Norway). **Thallium poisoning.** *Lancet* 2(7891): 1268; 1974. (1 reference)

In attempting to commit suicide, a woman ingested a quantity of rat poison corresponding to 7.8 mg/kg of thallium sulfate. A characteristic pigment deposition in the roots of the hair appeared around the third or fourth day after poisoning; this phenomenon is typically seen in persons poisoned with thallium sulfate. The pigmentation may be seen for several weeks after poisoning by observing some head hair under a light microscope in a solution of 10% NaOH; under these conditions the characteristic pigmentation quickly covers the root of the hair and tends to disappear after several minutes. This sign should aid the diagnosis of thallium poisoning when treatment is still possible.

75-2639. Thirumurthi, S.; Palaniswamy, P.; Subramaniam, T. R.; Kannammal, S. (Dep. Entomol., Tamil Nadu Agric. Univ., Coimbatote, India). **Effect of aerial spraying on non-target organisms inhabiting rice swamps.** *Madras Agric. J.* 60(7): 573-574; 1973. (5 references)

The effect of aerial spraying of fenthion and fenitrothion (0.5 kg/ha), and ambithion (1.0 kg/ha) was investigated on various aquatic fauna like insects, crustacea, amphibia, and fish. Almost all the pesticides were highly fatal to mosquito larvae, corixids, and odonata naiads with complete mortality. The beetles, hydrophilids and gyrinds, had some survivors. Ambithion accounted for complete mortality of hydrophilids and gyrinids. The mortality of the water scavenger beetles was 97.4% in phosphamidon followed by fenitrothion (88.9%) and leptophos (81.3%). Phosphamidon also accounted for the highest mortality of

gyrinid beetles. Their mortality in phosphamidon was 83.4% followed by 80.0% in fenthion. Fenthion and leptophos were extremely toxic to the crabs while fenithrothion, phosphamidon, and ambithion allowed 6.5%, 6.5%, and 5.0% survivors, respectively. All the chemicals were equally toxic to frogs.

75-2640. Zschiegner, H. J.; Becker, H. G.; Siemienkowicz, H. (Dir. Wiss. VEB Ausruestungen, Agrochem. Zentren, Leipzig, DDR). **Ursachen von Schandensfaellen durch chemische Pflanzenschutzmittel sowie Massnahmen zur ihrer Verhinderung und Regulierung. [Causes of damage by chemical pesticides and measures for their prevention and control.]** *Nachrichtenbl. Pflanzenschutzdienst DDR* 29(3): 56-60; 1975. (10 references) (German)

Some major aspects regarding damage following application of chemical plant protectives are outlined and measures for preventing and settling claims arising therefrom are discussed. At present, co-operative farms, state farms, horticultural production co-operatives, and their interfarm co-operative divisions for crop production can protect themselves by obtaining voluntary insurance against injury to soil products caused by chemical plant protectives. The insurance conditions are outlined and advice is given regarding notification of causes of damage. Categories of damage include losses of treated crops, pesticide ineffectiveness, damage to succeeding crops due to pesticide residues in soil, drift problems, and injuries to domestic animals and wildlife. Injuries to bee colonies are common following insecticide treatment, rodenticides are sometimes fatal to nontarget animals, and fish and fowl have died due to improper application.

75-2641. Bremer, R.; Fahlpahl, H. (Bienenschutzst. DDR, Bezirksinst. Veterinaerwesen, Potsdam, DDR). **Wege zur Verringerung der durch Pflanzenschutzmittel verursachten Schaeden an Bienenvoelkern und Erfahrungen bei der Zusammenarbeit zwischen Pflanzenschutz und Imkern. [Ways to reduce the damage to bee colonies due to plant protectives and experience regarding the cooperation between plant protection workers and beekeepers.]** *Nachrichtenbl. Pflanzenschutzdienst DDR* 29(6): 135-137; 1975. (1 reference) (German)

Ways to reduce the damage to bee colonies by pesticides are described on the basis of experience gained in the Rostock area. The schedule of pesticides application should be set up with respect to the scheduled passage of the colonies, and bee-keepers shall be notified of planned pesticides application in due time. Aerial application of pesticides shall be avoided as much as possible. Beekeepers shall be trained on how to prevent pesticide damages to their bees.

75-2642. Livingston, R. J.; Cripe, C. R.; Koenig, C. C.; Lewis, F. G., III; DeGrove, B. D. (Dep. Biol. Sci., Florida State Univ., Tallahassee, FL). **A system for the determination of chronic effects of pollutants on the physiology and behavior of marine organisms.** *Nat. Tech. Inform. Serv. COM* 74-11705, 1974, 19 p. (12 references)

It has been suggested that behavioral functions in estuarine organisms can be determined with respect to ecological changes, and that relatively low concentrations of pollutants can alter such behavior. For example, if bay sediments are contaminated with pesticides such as DDT and mirex, it is possible that some species will avoid these areas, thus causing them to be useless as nursery or breeding grounds even though there may be no overt, easily spotted signs that anything is wrong. The bioconcentration of pesticides with its resultant effects on the following generation of organisms is also considered. This type of insidious pollution can have serious effects on important fisheries without any detection by conventional methodology. A laboratory system designed for execution of controlled experiments on the effects of low levels of pesticides such as DDT and mirex on the behavior and physiology of several species of estuarine organisms is described. The system can determine quantitative changes in behavior under closely controlled conditions. By using a sound proof controlled environment room, there is a minimal amount of outside interference. Closed circuit television allows continuous monitoring in undisturbed surroundings, and is used effectively for rapid quantification of behavioral data. The long-term effects (sublethal) of pollutants on the behavior of key estuarine and coastal organisms will be studied by this system.

75-2643. Van Tiel, N. (Plant Protect. Serv., Wageningen, The Netherlands). **Principles and problems of pesticides legislation.** *Pestic. Sci.* 6(2): 189-197; 1975. (7 references)

The present paper deals with a number of aspects concerning principles and problems of pesticides legislation. Consideration is first given to the definition of the term pesticide, both in the context of legislation, which requires a precise description, and for the purpose of international organizations, such as for example the FAO/WHO Codex Alimentarius Commission. A general outline is given of the pesticide situation, summarizing the benefits derived from the use of pesticides, and the risks involved concerning man, environment, and food. The necessity of regulations in this field is stipulated, though it is emphasized that such regulations should not jeopardize justified plant health requirements. Consideration is further given to the criteria, which are relevant in any approval scheme, mandatory or voluntary, for pesticides. The main criteria should refer to efficacy and risk of undesirable side-effects on the basis of toxicological and environmental data. Reference is given to some principles of the present Netherlands Pesticides Act and of the proposed amendments. A survey is given of the present position within the European Economic Community with respect to harmonization of tolerances, and of the difficulties encountered in the FAO/WHO Codex Committee on Pesticide Residues in agreeing on international tolerances. A

certain degree of uncoupling of tolerance regulations from national use pattern regulations would be desirable. The question is raised whether it is theoretically possible to cover all requirements in one single tolerance figure, applicable world-wide, and thought might be given to a dual value system. (Author abstract by permission)

75-2644. Waitt, A. W. (Plant Protect. Ltd., Fernhurst, Haslemere, Surrey, England). **Pesticide legislation and industry.** *Pestic. Sci.* 6(2): 199-208; 1975. (19 references)

Pesticides are an essential part of modern agricultural technology required to provide high quality and high yields of food, feed and fibres. The pesticide industry faces widespread environmental concern, rising costs for research and development and increasingly stringent regulations. These pressures demand a highly critical appraisal of all stages of product evaluation, product development, and of capital investment. The safe use of pesticides is the joint responsibility of government and industry; their effective cooperation can only be assured by ready dialogue combined with willingness to compromise on legislation and registration procedures, nationally and internationally, for the benefit of improved technology. (Author abstract by permission)

75-2645. Pazderova, J.; Lukas, E.; Nemcova, M.; Spacilova, M.; Jirasek, L.; Kalensky, J.; John, J.; Jirasek, A.; Pickova, J. (Cent. Hyg. Natl., Univ. Prague, Prague, Czechoslovakia). **Chronicka otrava chlorovanymi uhlovokiky, vaniklymi pri vyrobe 2,4,5 trichlorfenoxyoctanu sodneho. [Chronic poisoning by chlorinated hydrocarbons formed in the production of 2,4,5 sodium trichlorophenoxyacetate.]** *Prac. Lek.* 26(9): 332-339; 1974. (26 references) (Czech)

Between 1965 and 1968, 80 workers involved in the production of 2,4,5 sodium trichlorophenoxyacetate and the butyl ester of trichlorophenoxyacetic acid became ill. The cause of these illnesses was 2,3,6,7 tetrachlorodibenzodioxime, but the toxic by-products, polychlorodibenzofurans, polychlorodiphenyls, and polychlorodiphenylethers, probably contributed. Long term studies of 55 patients revealed a majority had acne chloria of different degrees, 11 had symptoms of porphyria cutanea tarda, and nearly 50% of them suffer lipid metabolism disturbances (increased total cholesterol, lipaemia and lipoidic phosphor). Biochemical deviations, proving mild liver lesion, appeared during the early stages in 1/3 of the patients. Five patients examined by needle biopsy of the liver revealed signs of light steatosis or periportal fibrosis. Examination of 2 deceased victims revealed no signs of either condition. All seven cases evidenced fluoroescence of liver tissue in ultraviolet light whether or not there were simultaneous increases in excretion of uroporphyrins in urine. Another 17 victims showed symptoms of focal damage of the nervous system with a predominance of lesion of the peripheral neuron of the lower extremities. Heavy neurasthenic syndrome with vegetative symptoms were frequently experienced among various serious psychic disorders. In the other patients, symptoms of intoxication receded after initially worsening.

75-2646. Takahashi, K.; Nakamura, H.; Iwata, K. (Dep. Neuropathol., Brain Res. Inst., Fac. Med., Tottori Univ., Tottori, Japan). **[On the ultrafine structure of peripheral nerves in toxic polyneuropathy due to trichlorfon.]** *Rinsho Shinkei (Clin. Neurol.)* 15(7): 430-435; 1975. (18 references) (Japanese)

Delayed polyneuropathy of motor nerves, especially in lower extremities, was evidenced in a 37-yr-old male who ingested 120 mg of trichlorfon after drinking sake. Acute symptoms, such as blackout and unconsciousness, were observed. Recovery occurred after 2 wk. Sural nerve biopsy revealed considerable degeneration and loss of large myelinated fibers, and the changes found in unmyelinated fibers were less remarkable. Some myelinated fibers completely lost axons, leaving only the myelin bodies. Many clusters of Schwann cell processes, encircled by irregular infolding basement membranes, were observed in collagen tissues. Some clusters contained degenerated axons and some had regenerated ones. The present state of trichlorfon-induced neuropathy resembled that due to triorthocresyl phosphate, in both clinical and pathological features.

75-2647. Anonymous. **[Human accidents caused by pesticides.]** *Shokubutsu Boeki Sokuho (Plant Protect. News)* 1013: 5; 1975. (Japanese)

According to the Ministry of Health and Welfare, the number of pesticide accidents in 1974 in Japan was 641, 169 less than in 1973. Fatal cases amounted to 407, including suicides and murders. Accidents consisted of more than 500 cases of suicide and murder. One fatality and a total of 118 cases occurred during application and 18 cases (10 deaths) were due to errors.

75-2648. Ehrich, M.; Cohen, S. D. (Sch. Pharm., Univ. Connecticut,Storrs, CT). **In vitro inactivation of dichlorvos (DDVP) and inhibition of mouse tissue esterases.** *Toxicol. Appl. Pharmacol.* 33(1): 139; 1975.

Organophosphate (OP) inhibition of esterases other than acetylcholinesterase (AChE) may serve as a detoxification mechanism in that any OP bound to such esterases would not be available to inhibit the more critical enzyme, AChE. Malaoxon (MX), paraoxon (PX), and DDVP bind to and inhibit esterases. Prior inhibition of esterase binding by triorthocresyl phosphate (TCP) potentiates the anticholinesterase action of both MX and PX (*Toxicol. Appl. Pharmacol.* 27, 537, 1974). To determine the importance of DDVP's esterase binding, it and DDVP's anti-AChE action was compared on control and TCP-treated mice. Eighteen hour pretreatment with 125 mg/kg TCP reduced mouse liver binding detoxification of DDVP to 5% of con-

trol activity, but did not potentiate the in vivo anti-AChE action of subsequently administered DDVP. This suggests that even though DDVP binds to and inhibits esterases, the binding and inhibition do not represent important detoxification mechanisms for this compound. To compare the interaction of DDVP with esterase with those of MX, the inhibiton of esterases by each OP was studied in vitro. The concentrations of DDVP required for 50% inhibition were 0.084 ± 0.02, 0.43 ± 0.02, 6.9 ± 0.9, and 8.4 ± 0.4 for liver diethylsuccinate (DES), triacetin (TA), and procaine (Proc) esterases and cholinesterase (ChE), respectively. In similar studies with MX, the 50% inhibition concentrations were 26 ± 6, 0.28 ± 0.05, 40 ± 3, and 1900 ± 300 for liver DES, TA, Proc, and ChE, respectively. Fifty percent inhibition concentrations of DDVP and MX for brain AChE activity were 3.3 ± 0.3, and 1.6 ± 0.5 (× 0.1 μM), respectively. Thus, for brain AChE and liver TA esterase the sensitivity to inhibition by DDVP was similar to that for MX. There was, however, a marked difference in the sensitivities to these OP for both liver ChE and DES esterase. Both of these enzymes were much more sensitive to inhibition by DDVP, the OP which was not potentiated by TCP treatment. Thus, OP affinity for specific esterases may determine whether or not OP toxicity will be potentiated by prior esterase inhibition. (Author abstract by permission, Abstract No. 42)

75-2649. Hayes, W. J., Jr. (Cent. Environ. Toxicol., Dep. Biochem., Vanderbilt Univ. Sch. of Med., Nashville, TN). **Mortality from pesticides in 1969.** *Toxicol. Appl. Pharmacol.* 33(1): 145; 1975.

Through cooperation of the National Center for Health Statistics and the state departments of health, copies of certificates for deaths that occurred in the United States in 1969 were obtained for all categories under which accidental poisoning by pesticides could be classified. In order to investigate further each death in which association with a pesticide was established or could not be excluded, a letter was sent to the person who signed the certificate or to the hospital involved, or both. Most accidental deaths caused by pesticides now are reported under category E865, adopted in 1968 for that purpose. There was, in 1969, a substantial reduction in the number of pesticide-associated deaths compared to the annual numbers during the decade and a half prior in 1962 and even some reduction compared to 1968. This is true even though a few accidental deaths caused by pesticides still are reported in categories other than E865. As in the past, more than half of the victims are children; most are males; and a disproportional fraction are nonwhite. (Author abstract by permission, Abstract No. 57)

75-2650. Kramer, D.; Schmaland, G.; Manzke, E. (Inst. Wasserwirtschaft, Berlin, DDR). **Neue Erkenntnisse zum Verfahren der chemischen Entkrautung.** [**Chemical weed control.**] *Wasserwirtsch. Wassertech.* 24(7): 239-243; 1974. (8 references) (German)

New preparations available in East Germany for the control of emergent aquatic plants and their ichthyotoxicological data are presented. Sys 67 Omnidel-*N*, a wetting-agent-containing variant of Sys 67 Omnidel, is highly efficient in the control of monocotyledonous plants. The substantially higher fish toxicity of this preparation as compared with that of Sys 67 Omnidel is due to the presence of the wetting agent. A mixture of simazine, amitrole, and 2,4-D (CKB 1018) is a broad-spectrum herbicide to be used against emergent plants, which has replaced azaplant due to its low fish toxicity. Growth herbicides usually entail no toxicological problems in water bodies. However, the dosage of Selest should be limited to 0.9 g/m².

75-2651. World Health Org. Study Group (Geneva, Switzerland). **Early detection of health impairment in occupational exposure to health hazards.** *WHO Tech. Rep. Series.* 571: 1-88; 1975.

The principles underlying health monitoring in occupational health programs are discussed, and recommendations for appropriate action by governments, WHO, and occupational health institutions are given. Among the topics discussed is the early detection of health impairment due to organophosphorus and organochlorine insecticides. The toxic action of the organophosphorus insecticides is related to the inhibition of tissue cholinesterases and the subsequent accumulation of excessive amounts of acetylcholine at synaptic sites in effector organs. The development of symptoms depends both on the degree of inhibition and the rate at which it occurs. Since most of the effects of organophosphorus toxicology appear after the inhibition of cholinesterase has taken place, these effects cannot be regarded as early indicators of health impairment. The organochlorine insecticides show a wide range of acute toxicities and, because they accumulate in the fat, may induce pathological responses after chronic exposure. Determination of the insecticide concentration in the adipose tissues may serve as an index of chronic exposure. The toxic effects are nonspecific and may include changes in the microsomal activity in the liver, impairment of immunobiological reactivity, changes in lipoprotein and cholesteral metabolism, and neurological changes. The significance of such changes as an index of response and the relevance for health are yet to be established.

75-2652. Furuno, J.; Sugawara, N.; Funatsu, H.; Oki, S. (Sch. Leg. Med., Fac. Med., Yamaguchi Univ., Yamaguchi, Japan). [**Cholinesterase activity in the blood of a person fatally intoxicated by an organophosphorus pesticide.**] *Yamaguchi Igaku* 24(1): 27-31; 1975. (23 references) (Japanese)

Fenitrothion was detected as a yellowish brown spot on TLC in extracts of the stomach and blood of a 47-year-old suicide who ingested an unknown amount of fenitrothion after drinking sake. Death occurred in a hospital 4 hr after ingestion. Detection of fenitrothion by TLC of the

urine extract was unsuccessful. Determination of 3-methyl-4-nitrophenol, the hydroylsis product of fenitrothion, showed the content of fenitrothion of the stomach contents, blood, and urine, respectively, as 14.08 mg/300 ml, 54.15 μg/50 ml, and 27.08 μg/30 ml. The cholinesterase activity of serum and nematocytes of the dead man was 0.13 ΔpH and 0.39 ΔpH, respectively, as compared to the value in a healthy man, age 34, of 0.78 ΔpH and 2.08 ΔpH by the Piltz method.

See also **75-2563** **75-2564** **75-2594** **75-2760**

75-2653. Ohkawa, H.; Yoshihara, R.; Kohara, T.; Miyamoto, J. (Res. Dep., Pestic. Div., Sumitomo Chem. Co., Ltd., Takarazuka, Hyogo, Japan). **Metabolism of *m*-tolyl *N*-methylcarbamate (Tsumacide) in rats, houseflies and bean plants.** *Agric. Biol. Chem (Tokyo).* 38(5): 1035-1044; 1974. (22 references)

The life of *m*-tolyl *N*-methylcarbamate (Tsumacide, MT MC) in the rat body is very short. Depending on the sex, from 78 to 96.6% of an administered dose of ^{14}C-Tsumacide is eliminated in the urine by 24 hr after treatment. In rats, Tsumacide is mainly metabolized by oxidative reactions at the *m*-methyl group and 4-position of the aromatic ring. Hydrolysis of the ester linkage occurs only to a minor extent. The resulting oxidation products and phenols are partly conjugated as sulfates and glucuronides. The major metabolic pathways are identical in male and female rats. From 78.7 to 85.8% of the radiocarbon is rapidly lost from bean plants treated with ^{14}C-Tsumacide and Meobal by 24 hr after treatment. Approximately 70% of the dose is also lost within 24 hr after topical application of ^{14}C-Tsumacide to houseflies. Oxidation of the *m*-methyl group, *N*-methyl group, and the aromatic ring at the 4-position occurs with Tsumacide in houseflies and bean plants. Meobal undergoes hydroxylation at the 4-methyl group and *N*-methyl group in bean plants. Meobal undergoes hydroxylation at the 4-methyl group and *N*-methyl group in bean plants. The oxidation products are conjugated as glucuronides and glucosides in houseflies and as glucosides in bean plants. Tsumacide metabolites formed by oxidation are less active than the original compound in anticholinesterase activity. (Author abstract by permission)

2654. Okawa, H.; Shibaike, R.; Hatanaka, T.; Miyamoto, J. (Res. Dep., Pestic. Div., Sumitomo Chem. Ind. Co., Ltd., Takarazuka, Hyogo, Japan). **Metabolism of a fungicide, *S*-*n*-butyl *S*' - *p*-*tert* - butyl - benzyl *N* - 3 - pyridyldithiocarbonimidate (S-1358) in rats.** *Agric. Biol. Chem. (Tokyo.)* 39(8): 1605-1615; 1975. (14 references)

S-1358 was rapidly absorbed, metabolized and readily excreted via urine and feces from orally dosed rats. Excretion of radioactivity was almost complete within 4 days. The radioactivity was distributed mainly in stomach, intestines, liver and kidneys. It seems that S-1358 and its metabolites do not persist in organs and tissues following a single oral dosing. Major urinary metabolites of the benzyl-labeled S-1358 were *p* - (1,1 - dimethyl - 2 - hydroxyethyl)benzyl methyl sulfide [B], *p* - (1,1 - dimethyl - 2 - hydroxyethyl)benzyl methyl sulfone [A], *p* - (1 - methyl - 1 - carboxylethyl)benzyl methyl sulfide [D], *p* - (1 - methyl - 1 - carboxylethyl)benzyl methyl sulfone [C] and their glucuronide conjugates. Fecal metabolites were *S*-*n*-butyl *S*' - (1,1-dimethyl - 2 - hydroxyethyl)benzyl *N* - 3 -pyridyldithiocarbonimide [MR], A, B, C, and D. These metabolites were also found in the bile. The pyridine-labeled S-1358 gave rise to 2 - (3'-pyridylamino) - 4 - carboxylthiazolidine [HM] and 3-aminopyridine [AP] in the urine, and MR and AP in the feces. Intact S-1358 was a major component of the fecal radioactivity. (Author abstract by permission)

75-2655. Kendall, M. W. (Dep. Anat., Univ. Mississippi Med. Cent., Jackson, MS). **Acute histopathologic alterations induced in livers of rat, mouse, and quail by the fire-ant poison, mirex.** *Anat. Rec.* 178(2): 388; 1974.

The fire-ant poison mirex was injected i.p. or mixed with normal diet to ascertain histopathological alterations induced by the compound in livers of rats, mice, and quail. It was expected that histological variations from controls would be similar to those found with DDT, as mirex is also a chlorinated hydrocarbon. Generally, this seemed to be the case, as all experimental animals showed toxic symptoms of hair loss, diarrhea, and listlessness similar to acute DDT intoxication. In rats and mice, fatty changes occurred in the liver and were manifested as periportal liposis at LD50 dosages (rats, 700 ppm; mice, 330 ppm). Quail showed isolated patches of cellular liposis at the LD50 dosage of 300 ppm. Animals were sacrificed 10 days after administration of mirex. In rats and mice injected i.p. with a corn oil solution of mirex, fibrous, white, patchy lesions developed on the surface of livers and extended several millimeters into the interior where cellular necrosis was evident inside these well circumscribed lesions.

75-2656. Luckner, C.; Schulman, A. H. (Author address not given). **Effects of DDT on imprinting in neonatal turkeys.** *Am. Zool.* 13(4): 1268-1269; 1973.

Turkey poults were injected i.p. early on the morning of hatch with either physiological saline, mineral oil, 1.0 mg DDT/kg body weight dissolved in mineral oil, or 10.0 mg DDT/kg body weight dissolved in mineral oil. A control group received no injections. Some turkeys were tested on days 1-7 posthatch in an operant imprinting chamber where the animal was required to peck a key in order to view the imprinting stimulus. Others were tested on days 2-8 posthatch in a social choice apparatus in which subjects' preference for a conspecific or a mirror image was timed. DDT at both dose levels delayed the critical period, or peak performance, by 2 to 3 days in both tests and enhanced learning of the pecking response in the operant imprinting procedure. Suggestions as to the cause(s) of these results are discussed.

75-2657. Stanton, R. H.; Khan, M. A. Q. (Dep. Biol. Sci., Univ. Illinois Chicago Circle, Chicago, IL). **Hepatic mixed-function oxidase in freshwater fishes: metabolism of and interaction with cyclodiene insecticides and their photoisomers.** *Am. Zool.* 13(4): 1308; 1973.

The epoxidation and hydroxylation reactions of several cyclodiene insecticides are catalyzed by hepatic mixed-function oxidase (MFO) in freshwater fishes such as bass, bluegill, trout, oscar, peacock, Congo cichlids, and barbs. Differences in the rates of oxidation exist. The fry have 3 times and 1.5 times higher activity that older and

younger adults, respectively. Bluegill fry MFO with the highest rate of epoxidation and hydroxylation is about 1.5 times less active than the male mouse MFO (2.4 vs 3.4 mm/min/ng protein). Chlordene undergoes both of these oxidations simultaneously with epoxidation rates always higher than that of hydroxylation, while in the mouse the reverse is true. Differences in the levels of activity appear to correlate well with the differences in P-450 content. A similar pattern between MFO activity and NADPH-cytochrome c-reductase activity and cytochrome b_5 concentration is also observed in these animals. Competitive inhibition between structurally similar cyclodienes: aldrin, isodrin, photoaldrin, heptachlor, and chlordene was noted. Structurally similar cyclodienes which are not metabolized by the MFO such as chlordane also inhibit epoxidation and hydroxylation reactions indicating that the binding site of the cyclodienes may not be the site for oxygenation.

75-2658. Runnels, J. M.; Khan, M. A. Q. (Dep. Biol. Sci., Univ. Illinois Chicago Circle, Chicago, IL). **Hepatic mixed-function oxidase activity towards cyclodiene insecticides in the domestic pigeon.** *Am. Zool.* 13(4): 1308-1309; 1973.

Mixed-function oxidase activity towards cyclodiene insecticidal substrates was studied in the homing and roller strains of the domestic pigeon, *Columbia livia*. Both epoxidation and hydroxylations are catalyzed at the same pH and temperature. Both reactions are simultaneous, occurring at similar rates during initial states of oxidation, but later the hydroxylation rate becomes higher than epoxidation. The epoxidase activity is about 50 times less than in the male mouse, and about the same as in Japanese quail. This is related to differences in P-450, b_5, and NADPH-cytochrome c-reductase concentrations which are about 6, 6, and 4 times lower, respectively, than in the male mouse. Interactions between cyclodienes and other type I and type II substrates with P-450 have been inspected.

75-2659. Kerr, W. E. (Georgia Inst. Technol., Altanta, GA 30332). **2,4,5-Trichlorophenoxyacetic acid toxicity in developing chick embryos.** *Am. Zool.* 13(4): 1324; 1973.

Practical grade 2,4,5-T is fetocidal in chicken embryos when introduced at levels of 250 mg/kg. Eggs were candled on the 6th day of incubation to determine embryo viability prior to administration of the herbicide. All injections were introduced into the air space of each egg on the 7th day of incubation, using dimethyl sulfoxide as a vehicle. In all cases the fetal development of injected eggs stopped by day 8, while all controls hatched after normal incubation. Further experimentation is needed to determine the teratogenic capabilities of 2,4,5-T at lower doses.

75-2660. Petrocelli, S. R.; Anderson, J. W.; Hanks, A. R. (Texas A. & M. Univ., College Station, TX 77843). **Interactions of dieldrin with sediments and biota of an estuarine system.** *Am. Zool.* 13(4): 1326-1327; 1973.

Laboratory experiments were conducted to assess the interactions among dieldrin, sediments, and selected biota of the San Antonio Bay, Texas estuarine system. Sediments adsorbed up to 80% of the dieldrin to which they were exposed, with an equilibrium established within the first hr of exposure, but desorbed only insignificant amounts (10-12%) upon resuspension in clean seawater. The bivalved mollusca, *Rangia cuneata* and *Crassostrea virginica*, exposed to contaminated sediments in a flowing seawater system, accumulated dieldrin residues of 10-23% of sediment levels. *Rangia* clams accumulated dieldrin directly from a sea water solution to levels of 1934 *mg*/kg (3517 times ambient) in 96 hr. Exposure of *Rangia* to log concentrations (5.0, 50.0, 500 μg/l) of dieldrin in solution resulted in residue levels in tissues of 30.85, 309.2, and 2848 μg/kg, respectively. The marine phytoplankter, *Dunaliella peircei*, exposed to a dieldrin solution of 10 μg/l for 96 hr concentrated this insecticide 1210 times ambient. *Rangia* fed contaminated algae accumulated dieldrin residues to 54 times initial algae residue concentration. Blue crabs (*Callinectes sapidus*) fed dieldrin-contaminated *Rangia* meat had dieldrin magnification factors of up to 6.8. The possibility of magnification of dieldrin residues in a food chain was demonstrated.

75-2661. DeRosa, C.; Taylor, D. H. (Miami Univ., Oxford, OH 45056). **Effects of the pesticide "sevin" on the reproductive biology of Japanese quail.** *Am. Zool.* 13(4): 1327; 1973.

Japanese quail (*Coturnix coturnix japonica*) were exposed to sevin (carbaryl, 1-naphthyl-*N*-methylcarbamate) at concentrations of 20, 40, and 400 ppm and monitored for 21 days to observe modifications in their reproductive biology and behavior. Differences were noted in the levels of pesticide excreted in the 3 experimental groups during the first 48 hr following exposure, after which pesticides levels in the excreta approached zero. Additionally, significant amounts of the pesticide were detected in the egg yolks after pesticide ingestion. Modifications in the agonistic behavior of male and female quail were noted following pesticide ingestion.

75-2662. Lafont, P. (Unite de Recherche de Toxicologie Alimentaire, I.N.S.E.R.M., Le Vesinet, France). **Apports et limites de la bacteriologie et de la mycologie en toxicologie alimentaire. [Contributions and limits of bacteriology and mycology in food toxicology.]** *Ann. Nutr. Aliment.* 28(4): 243-248; 1974. (21 references) (French)

Contributions and limitations of bacteriology and mycology in food toxicology, especially in connection with mycotoxins and chemical and pesticide residues are discussed. Chemical and pesticide residue metabolism and biodegradation are studied using axenic or mixed soil and aquatic cultures of microorganisms under in vitro conditions. The relevance of such microbiological experiments is limited in view of the impossibility of reproducing all the environmental conditions which may affect the fate of

such residues in vitro. The phage particle formation induction activity of lysogenic bacteria is used to detect mutagenic, carcinogenic, and teratogenic substances. The presence of mutagenic substances can be revealed by means of Enterobacter or yeast cultures. The total chemcial micropollutant content of water can be estimated by means of Actinomycetales.

75-2663. Suschetet, M.; Causeret, J. (Station Recherche Qualite Aliments l'Homme, I.N.R.A., Dijon, France). **Facteurs nutritionnels et toxicite: propositions d'applications a la methodologie des etudes de toxicologie alimentaire.** [**Nutritional and toxic factors: application proposals according to food toxicology study methods.**] *Ann. Nutr. Aliment.* 28(4): 307-316; 1974. (35 references) (French)

Studies on the relationships between dietary components and the toxicity of residues of pesticides and other substances, on the effects of residues on certain biochemical parameters are reviewed. Short-term toxicity tests with chlordane, DDT, endosulfan, aldrin, lindane, toxaphene, demeton, diazinon, dimethoate, malathion, parathion, chlorpropham, diuron, monuron, and captan revealed reduced LD50 values in animals kept on protein-free or low-protein diet. This phenomenon was not observed with heptachlor due to the reduction of the activity of liver microsomal enzymes under low-protein diet, and an accordingly reduced metabolism by these enzymes of heptachlor to more toxic heptachlor epoxide. Thiamine seems to inhibit the metabolism of heptachlor. Reduction of the vitamin A level in the liver, and an increase in the vitamin A level in the serum were observed in cattle fed adiet with 40-60 ppm DDT. A similar phenomenon was also observed in human serum. Parathion and dieldrin did not cause such changes in similar animal tests.

75-2664. Albrecht, R.; Manchon, P. (Inst. Sci. Tech. Aliment., Paris, France). **Influence de l'environnement sur le metabolisme des molecules exogenes dans les microsomes du foie.** [**Environmental influence on the metabolism of exogenic materials in liver microsomes.**] *Ann. Nutr. Aliment.* 28(4): 351-363; 1974. (10 references) (French)

Studies on the influence of pesticides on the metabolism of exogenic and endogenic substances by liver microsomal enzymes are reviewed. Organochlorine pesticides such as DDT, dieldrin, aldrin, endrin, kelthane rhotane, perthane, lindane, methoxychlor, and DDE were found to reduce the barbiturate-induced sleep by accelerating their metabolism in liver microsomes. Organophosphorus pesticides appear to inhibit the liver microsomal enzymes. Organochlorine insecticides also interfere with the normal metabolism of endogeneous substances. Chlordane administered i.p. to adult rats in a dosis of 10 mg/kg increased the metabolism of 17-β-estradiol by 7 times. Both chlordane and DDT stimulate the hydroxylation of testosterone into 16-β testosterone, which may be the cause for the reduced fertility of affected animals. Stimulation of the metabolism of testosterone and progesterone by dieldrin was observed.

75-2665. Lowy, R.; Derache, R. (Lab. Nutrition Humaine, I.N.S.E.R.M., Paris, France). **Consequences du metabolisme des insecticides sur les voies de la bioenergetique cellulaire.** [**Consequences of insecticide metabolism on the paths of cellular bioenergetics.**] *Ann. Nutr. Aliment.* 28(4): 365-374; 1974. (9 references) (French)

Studies on the action of organochlorine, organophosphorus, and methylcarbamate pesticides on different enzymes, the effects on enzyme systems on these pesticides, and on the consequences of these processes on the paths of cellular bioenergetics are reviewed. Organophosphorus pesticides inhibit acetylcholinesterase in nervous tissues and erythrocytes and in plasma cholinesterase. Organochlorine insecticides, such as DDT, inhibit ATPases in different tissues in vitro and in vivo. Organophosphorus insecticides and methylcarbamates inhibit mixed function microsomal oxidases, while organochlorines induce the synthesis of oxidases and cytochrome 450. The latter leads to rapid metabolism of certain drugs and hormones. Stimulation of the pentose pathway, of the synthesis of certain RNAs, of glucose-6-phosphate dehydrogenase, and of glucose metabolism due to DDT were observed. Inhibition of the lipase activity in adipose tissue by parathion was observed. Organophosphorus insecticides and methylcarbamates are detoxified by esterases. Organophosphorus compounds are metabolized by glutathione sulfotransferases and reduced glutathione, while the metabolism of DDT is due to DDT dehydrochlorinase using reduced glutathione as a cofactor. The inhibition of ATPases and the use of reduced cofactors for the metabolism of insecticides result in the continued oxidation of the substrates by the mitochondria without transforming the heat into chemical energy in the form of ATP.

75-2666. Legator, M.; Zimmering, S. (Div. Biol. Med. Sci., Brown Univ., Providence, RI 02908). **Genetic toxicology.** *Annu. Rev. Pharmacol.* 15: 387-408; 1975. (116 references)

The mutagenicity of man-made chemicals is discussed with reference to the principal types of mutation important to man, methodologies in mutagenicity testing, genetic procedures using *Drosphila melanogaster*, the detection and characterization of chemical mutagens, combined testing programs in rodents, population monitoring, and commercial chemicals with suspected mutagenic activity. Included in the latter category is the widely used agricultural fungicide captan. The mechanism of action of this chemical is believed to be the result of its reactivity with thiol groups; depending on the nature of the reacting thiol, captan can give rise to several end products. In high doses, captan can be quite toxic in laboratory animals when administered systemically, and its administration has been associated with increased chromatid breaks, increased mitotic gene conversion, congenital embryonic malformations, and increased mutations in various laboratory animals and indicator organisms. The results with captan suggest a direct acting mutagen in the sense

that host metabolism is not required for activation. Since many studies in Drosophila and other animals indicate no mutagenic activity, captan may be an example of an active mutagen that is detoxified in an intact host. The widespread use of this compound and the information available to date would place this compound in a high priority category for further animal studies.

75-2667. Stanlake, G. J.; Clark, J. B. (Dep. Bot. Microbiol., Univ. Oklahoma, Norman, OK 73069). **Effects of a commercial malathion preparation on selected soil bacteria.** *Appl. Microbiol.* 30(2): 335-336; 1975. (9 references)

A commercial malathion solution was separated by simple distillation at less than 155°C into a malathion fraction and a solvent fraction which were tested for their effects on a soil community and on selected soil bacteria growing as axenic cultures. The fractions were applied to the soil community at 0.44 μl/g soil, and were added to the log-phase axenic cultures at 400 μl/l. Neither fraction significantly affected growth in the natural soil community, and the malathion fraction had no bactericidal effect on the axenic cultures. The solvent fraction, on the other hand, had a significant bacteriocidal effect, the effect varying according to the organism tested and the medium used (tryptone-glucose-yeast extract broth or a mineral salts-0.5% succinate broth with 0.01% yeast extract).

75-2668. Convent, B.; Briquet, M. (Lab. Enzymol., Catholic Univ. Louvain, Belgium). **Diuron and related herbicides, inhibitors of the oxidation of mitochondrial cytochrome *b* in *Saccharomyces cerevisiae*.** *Arch. Int. Physiol. Biochim.* 83(2): 358-359; 1975. (5 references)

The apparent *K*i for the inhibiton of the oxidation of succinate by yeast mitochondria were determined for several urea herbicides. The electronic as well as the hydrophilic and steric properties of the phenyl and imino nitrogen substituents greatly influenced the inhibitory properties of these molecules. In addition, the action of diuron on mitochondrial state 4 respiration and on succinate:cytochrome c oxidoreductase was compared to that of antimycin A. Although diuron and antimycin A act between both cytochromes b and c_1 of the respiratory chain, the rate of inhibition versus concentration of diuron yields hyperbolic kinetics whereas antimycin A shows a sigmoidal inhibition curve. Combined effects of antimycin A and diuron on yeast mitochondrial state 4 respiration as well as the apparent *K*i of diuron is significantly decreased in the presence of antimycin A. The interaction coefficient between antimycin A and diuron was 0.4, suggesting that antimycin A-induced conformational change in the b-c_1 segment of the respiratory chain allows diuron to bind more tightly to its site of action.

75-2669. Cox, D. P. (Dep. Agron., Cornell Univ., Ithaca, NY 14850). **Microbiological methylation of arsenic.** *IN: Arsenical Pesticides, ACS Symposium Series 7.* Woolson, E. A., ed., Washington, DC, American Chemical Society, 1975, p. 81-96. (21 references)

Evidence for the methylations of arsenic compounds by three mold species from sewage is presented. The frequent use of arsenic compounds as pesticides provides a potential hazard if closed biological systems containing populations capable of methylating are exposed to arsenicals. One of the 3 species, a yeast, methylates selenium and probably tellurium anions as well as arsenic compounds. The methylation mechanisms for selenium and arsenic in this organism appear partly found in a common pathway. Despite the widespread use of arsenic compounds, little is known of the behavior of this element in natural ecosystems and with regard to the potential hazard of arsenic poisoning, the need for further study is thus self-evident.

75-2670. Woolson, E. A. (Pesticide Degradation Lab., ARS, USDA, Beltsville, MD 20705). **Bioaccumulation of arsenicals.** *IN: Arsenical Pesticides, ACS Symposium Series 7.* Woolson, E. A., ed., Washington, DC, American Chemical Society, 1975, p. 97-107. (37 references)

Arsenic is bioconcentrated by aquatic organisms, but not biomagnified. Plants usually accumulate more arsenic than fish, and crustacea accumulate intermediate amounts. Marine organisms normally contain more arsenic than their fresh water counterparts. However, the arsenic contained in the organisms is apparently not toxic to animals or humans, and is readily excreted.

75-2671. Braman, R. S. (Univ. South Florida, Tampa, FL 33620). **Arsenic in the environment.** *IN: Arsenical Pesticides, ACS Symposium Series 7.* Woolson, E. A., ed., Washington, DC, American Chemical Society, 1975, p. 108-123. (17 references)

Analytical methods available for detecting arsenic in the environment are considered. The various environmental forms of arsenic and environmental transformations are discussed. It is concluded that the presence of methylarsenic compounds in the environment has been confirmed. Adequate analytical methods of their study are available. Early work indicates that commercially used arsenicals are biomethylated to volatile forms which must undergo at least some local and possibly global migration. Even phenylarsenic type compounds can be converted to trimethylarsine. Ambient volatile arsenic in the air may be well below 1 ng/m^3 in the absence of a soil contamination with arsenic. However, air analyses have been limited to only a few locations. Further work is needed.

75-2672. Iverson, F. (Pestic. Sect., Health Protection Branch, Tunney's Pasture, Ottawa, Ontario, Canada). **Affinity and carbamylation rate constants of propoxur in reaction with erythroycte and serum cholinesterase.** *Biochem. Pharmacol.* 24(16): 1537-1538; 1975. (6 references)

Propoxur is a commonly used pesticide. The car-

bamylation and affinity constants of propoxur have been determined for commercially available bovine erythrocyte acetylcholinesterase and horse serum cholinesterase. In contrast to the organophosphate diisopropylfluorophosphate, DFP, the inhibitory effect of propoxur on acetylcholinesterase is greater because its carbamylation rate is higher, 70.5/min and 5.8/min for the erythrocyte and serum enzymes, respectively. The affinity of propoxur for acetylcholinesterase (1.54 m*M*) is similar to that for serum cholinesterase (1.44 m*M*). Although the enzyme sources used in this study are from different species, it is suggested that the inhibitory effects noted with propoxur in the human studies can also be attributed to variations in carbamylation rates rather than affinity. The differences in the affinities of DFP and propoxur for the two enzymes are not surprising, since the chemical structure of these inhibitors is quite different. However, the significant variation in the contribution of affinity to inhibition suggests that attempts should be made to measure the individual inhibition constants before attributing variations in inhibition rates to differences in affinity.

75-2673. Herz, F. (Albert Einstein Coll. Med., Dep. Pathol., Montefiore Hosp. Med. Cent., Bronx, New York, NY 10467). **Acetylcholinesterase inactivation in young and old human red blood cells.** *Blut* 31(1): 17-20; 1975. (14 references)

A comparison was made of the effects of enzyme-inactivating agents on the acetylcholinesterase (AChE) of young and old human erythrocytes. Normal red cells and AChE-deficient red cells were separated in accordance with their densities and then exposed to trypsin, cephalothin, and tannic acid. The results indicated that the procedure used yielded two cell populations which were distinct from the original red cell specimens and dissimilar with respect to each other. This was substantiated by finding increased AChE activity in the lighter cells and lower activity in the heavier cells as compared to the activity in the unfractionated cell specimens. This pattern of AChE distribution is reversed in patients with paroxysmal nocturnal hemoglobinuria (PNH), since a dual population of young cells exists in this condition, one short lived and another with normal survival, one complement sensitive and another, complement insensitive. Results of experimentation indicate that agents used to inactivate the AChE activity of the membrane in whole red cells do not discriminate between young and old cells. Thus, under conditions of this study, 65 to 70% of the enzyme activity was lost following trypsin treatment (1 mg/ml); exposure to cephalothin (50 mg/ml) and tannic acid (0.05 mg/ml) caused 50 and 65% to 70% inactivation, respectively. It is noted that, despite the fact that young cells of the PNH patient are severely deficient in AChE activity, the effect of these agents was qualitatively similar to that observed with the red cells of normal individuals. Examinations showed that red cells of newborn infants, although they differ in many respects from cells of adults, did not respond differently in these tests. This was also true for red cells from infants affected with ABO HDN, which characteristically have lower AChE activity than cells from normal newborns. Thus, it is concluded that, although the human erythrocyte undergoes many morphological and metabolic modifications during its lifespan, these alterations do not include changes in the susceptibility of the surface-located AChE to agents that modify the activity of this enzyme in vitro. Therefore, the in vitro modification of red cell AChE activity is independent of cellular age and the initial specific activity.

75-2674. Parouty, G.; Chaisemartin, C. (Lab. Biol. Anim., U.E.R. Sciences, Limoges, France). **Analyse experimentale des transferts d'un micropolluant (^{65}Zn) au consommateur terminal dans un exosysteme dulcaquicole. [Experimental analysis of zinc salt transference to final consumer in a freshwater ecosystem.]** *C. R. Seances Soc. Biol. Filiales* 168(1): 78-82; 1974. (17 references) (French)

The accumulation of zinc salts through fresh-water trophic chains was simulated in a biocenosis using Zn-enriched Daphnia, *Lymnaea limosa*, *Cobitis barbatula*, and crayfish, and ^{65}Zn-labeled zinc chloride. *Lymnaea limosa* and *C. barbatula* were kept in fresh water with 5 μCi/l of ^{65}Zn, or *C. barbatula* were fed ^{65}Zn-enriched Daphnia. An equilibrium of the Zn concentration with 26 μg Zn per g of fresh tissue was reached in *L. limosa* in 25 days. Slight accumulation of Zn was observed in *C. barbatula* fed Zn-enriched Daphnia for 30 days. The Zn concentration in the dorsal muscle was not higher than 7 μg/g. The contamination due to ingestion was minimal relative to that due to contaminated water even if the Zn concentration in the water was much lower than that in the food. The same phenomenon was also observed in crayfish fed on *C. barbatula* and *L. limosa*. An initial increase in the radioactivity during and immediately after feeding was followed by a considerable drop 24 hr after feeding, and an equilibrium was reached in 20 days. The overall residual activity was 108±26 nCi/g, and that due to the ingestion of contaminated *L. limosa* and *C. barbatula* was only 11-42 nCi/g.

75-2675. Tooby, T. E.; Hursey, P. A.; Alabaster, J. S. (Salmon Freshwater Fish. Lab., Ministry Agric., Fisheries Food, London, England). **The acute toxicity of 102 pesticides and miscellaneous substances to fish.** *Chem. Ind. (London)* 12: 523-526; 1975. (6 references)

The acute toxicities of a variety of pesticides for the harlequin fish (*Rasbora heteromorpha* Duncker) were tested using a constant-flow laboratory procedure. In each case, the 24, 48, and 96 LC50 values were determined. The LC50s of the insecticides ranged from 750 mg/l for azodrin (active ingredient monocrotophos) to 0.008 mg/l for NRDC 107 (active ingredient mecarbam), while those of the fungicides ranged from 1000 mg/l for polyram (active ingredient metiram) to 0.02 mg/l for thiram 80 (active ingredient thiram) and those of the microbicides ranged from 9600 mg/l for Doxcide 50 (active ingredient chlorine dioxide) to

0.09 mg/l for Thion (active ingredient organo-sulfur). Three formulations of Derris had slightly different toxicities although they contained the same percentage of rotenone, and the various dithiocarbamate fungicides showed a wide range of acute toxicity to fish. The toxicity of the polychlorinated biphenyls increased with increasing chlorine concentration, and the toxicities of two microbicides (Chloramine-T and Wescodyne) used to control fish parasites increased with decrease in pH and water hardness. Extrapolated 3-month LC50 values are given for most of the chemicals studied.

75-2676. Oehme, F. W. (Kansas State Univ., Comparative Toxicol. Lab., Manhattan, KS). **Comparative toxicology: the study of poisons in all animal species.** *Clin. Toxicol.* 7(2): 212-213; 1974.

Toxicologic studies have been conducted in various species of animals in order to provide information on probable circumstances in man because of animals' economy and ease of handling, and because some animals are especially sensitive in their response to certain toxins. Investigations of the fungal toxins identified a number of hepatotoxic, nephrotoxic, and carcinogenic compounds. The treatment of ethylene glycol poisoning was assisted by a clarification of the mechanisms involved. Potential hazards from chemical residues in human foods were extensively studied in various animals, and problems produced by antibiotics, therapeutic agents, pesticides, heavy metals, and feed additives are under close examination by regulatory agencies. The validity of animal toxicity data is important to the formulation of workable guidelines in the use of these chemicals around food producing animals. Health hazards e.g. those due to nitrates are often first identified in livestock or companion animals and then related to human disorders. The wide area of chemical interactions due to the large number of available human therapeutic agents is being studied in animals to provide criteria for their successful application in man.

75-2677. Junge, W.; Krisch, K. (Bundeswehr-Hosp., Hamburg, Germany). **The carboxylesterases/amidases of mammalian liver and their possible significance.** *Crit. Rev. Toxicol.* 3(4): 371-434; 1975. (306 references)

The occurrence, preparation, molecular properties, and catalytic properties of the carboxylesterases/amidases of mammalian liver are reviewed. Among the compounds which are degraded by specific enzymes of this group are the pyrethroids, a group of insecticidal esters from pyrethrum flowers. These compounds are hydrolyzed by specific esterases or unspecific carboxylesterases of mouse liver microsomes. Depending on the pyrethroid, either the esterase and/or mixed-function oxygenases may limit the toxicity of these compounds in mice. Carboxylesterase inhibitors include various organophosphorus and carbamate compounds. The reaction of an organophosphorus inhibitor with a carboxylesterase is a stoichiometric reaction. Some organophosphorus compounds are highly toxic because of their inhibitory actions on acetylcholinesterase, but other compounds in this category act selectively on unspecific carboxylesterases. The latter compounds are less toxic than the former, although chronic administration produces characteristic neurological symptoms. The oldest and most widely known carbamate is physostigmine, which inhibits all types of cholinesterases but has less effect on the unspecific carboxylesterases.

75-2678. Zutshi, U.; Kaul, B. L. (Reg. Res. Lab., Jammu 180001, India). **Studies on the cytogenetic activity of some common fungicides in higher plants.** *Cytobios* 12(4/5): 61-67; 1975. (29 references)

The effect of 13 fungicides on the germination, seedling injury, and chromosome abnormalities in seeds of barley (*Hordeum vulgare*) and the spectrum and frequency of chromsomal aberrations in secondary roots of *Vicia faba* were investigated. Sixteen fungicides (including copper fungicides, carbamates, inorganic and organic sulfur fungicides, and mercurials) reduced the percentage of seed germination, induced seedling injury, and produced cytological anomalies of varying degrees in barley. More potent fungicides were further tested in the secondary roots and produced a significant amount of chromosomal aberrations in the form of chromatid and isolocus breaks and exchanges of chromatid type. Dexon (fenaminosulf), benlate (benomyl), ceresan (ethylmercury chloride), a coppersan, lonocol (zineb), morestan (oxythioquinox), hexasan (phenylmercury chloride), and karathane (dinocap) are classified as strong radiomimetic agents, producing seedling lethality of 24-53.2% and a 29.55% level of cytologically aberrant cells in barley. It is concluded that they constitute genetic and environment hazards of great magnitude to the ecosystem where they are released.

75-2679. Lock, S.; Witschi, H.; Skelton, F. S.; Hanasono, G.; Plaa, G. L. (Dep. Pharmacol., Fac. Med., Univ. Montreal, Montreal, Quebec, Canada). **Effect of cyclohexamide on the distribution of α-naphthylisothiocyanate in rats.** *Exp. Mol. Pathol.* 21(2): 237-245; 1974. (12 references)

The effects of cyclohexamide on the tissue distribution of α-naphthylisothiocyanate (ANIT) labeled with ^{14}C or ^{3}H were examined. Previous experiments have shown that, in rats, the administration of cycloheximide (2 mg/kg) within 2 hr before or after 300 mg/kg of ANIT blocks the development of hyperbilirubinemia and cholestasis. Less ANIT-derived radioactivity was found in blood, liver, fat, and several other tissues of cyclohexamide-treated animals at various times after ANIT than in controls. More ^{3}H than ^{14}C was excreted in bile during the first 8 hr after administration in rats given a mixture of (naphthyl-4-^{3}H) ANIT and (isothiocyanate-^{14}C) ANIT with a $^{3}H/^{14}C$ ratio of 6.3. Cycloheximide-treated rats showed no change in the $^{3}H/^{14}C$ ratio. Data suggests that normal animals excrete an ANIT metabolite in their bile from which the ^{14}C

label in the isothiocyanate moiety has been lost, but this does not happen in cycloheximide-treated animals. This provides further evidence that biotransformation of ANIT is necessary for the development of hyperbilirubinemia and cholestasis. Bile may be a convenient starting material for isolating and identifying ANIT metabolites.

75-2680. Singh, B. D.; Harvey, B. L. (Dep. Genet. Plant Breeding, Fac. Agr., Banaras Hindu Univ., Baranasi 221005, India). **Does 2,4-D induce mitotic irregularities in plant tissue cultures?** *Experientia* 31(7): 785-787; 1975.

Suspension cultures of *Vicia hajastana* and *Haplopappus gracilis* were maintained in B5 medium containing 0.1, 1.0, and 10.0 and 0.1, 0.5, 1.0, and 5.0 μ/ml 2,4-D, respectively. Anaphase analyses from both the species showed a number of abnormalities. The concentration of 2,4-D in the culture medium had a marked effect on the frequency of abnormal anaphase configurations, i.e., the higher the concentration, the lower the frequency. This relationship existed because the frequency of anaphase bridges, including interlocking in the case of *Vicia*, showed a strong negative association with the 2,4-D concentration. In the case of *Vicia*, the frequency of dicentric chromosomes at metaphase also showed a similar trend. However, no dicentric chromsomes were observed at metaphase in the suspension cultures of *H. gracilis*. The anaphase bridges in *H. gracilis* were most likely produced by a breakage-fusion-bridge cycle. Apparently 2,4-D reduced the changes of reunion of damaged chromosome ends, probably by stabilizing them in some way.

75-2681. Bahig, M. R. E. (Dep. Radioisotopes, Atomic Energy Est., Cairo, UAR). **Effect of subacute poisoning by cyolane on acetylcholine esterase and succinic dehydrogenase in the rat.** *Experientia* 31(7): 836-837; 1975. (14 references)

The effect of cyolane on rat acetylcholinesterase activity in brain and blood and on liver succinic dehydrogenase activity was investigated. Cyolane was given daily per os at doses corresponding to 0.9, 0.18, 0.09, and 0.045 mg/kg (1/10, 1/50, 1/100, and 1/200 of LD50 respectively) for 1, 2 and 4 wk. Treatment resulted in a decrease in acetylcholinesterase activity of brain, erythrocytes, and plasma. This inhibition was comparable to that produced by other organophosphorus pesticides. The extent of inhibition of acetylcholinesterase and succinic dehydrogenase was proportional to the cyolane dose.

75-2682. Kagan, Yu. S.; Kokshareva, N. V.; Sasinovich, L. M.; Krivenchuk, V. E. (Lab. Gen. Toxicol., All-Union Res. Inst. Hyg. Toxicol. Pestic., Polymers, and Plastics, Kiev, USSR). **Eksperimental'nyye dannyye o novom reaktivatore kholinesterazi iz gruppi tiogidroksimovikh efirov. [Experimental data on new cholinesterase reactivators of the group of thiohydroximic ethers.]** *Farmakol. Tokiskol. (Moscow)* 38(3): 294-298; 1975. (11 references) (Russian)

Data on the effectiveness of a new cholinesterase reactivator, diethyxime (*p*-bromobenzthiohydroximic *S*-diethylaminoethylate) are presented. The single dose and multiple administration toxicity were studied. Diethyxime shows a significant antidotal action in the dosage range of 10-490 mg/kg. The drug, experimentally, is shown to be capable of restoring cholinesterase inhibited by dimethyldichlorovinyl phosphate (dichlorvos), preventing neuromuscular blocking of impulse conduction, and normalizing cardiovascular system functions. It is less toxic than dipyroxime which is presently used as a reactivator. Administration to warm-blooded animals does not produce any side effects on a number of systems and organs.

75-2683. Protas, L. L.; Muske, G. A.; Mndzhoyan, O. L.; Danilov, A. F.; Mikhelson, M. Ya. (I. M. Sechenov Inst. Evol. Physiol. Biokhim., Leningrad, USSR). **Vliyaniye ingibitorov i reaktivatorov kholinesteraz na blokiruyushchyeye deistviye aminoefirov dikarbonovikh kislot na nervno-mishechnoe provedeniye. [Influence of cholinesterase inhibitors and reactivators on the blocking effect of diaminocarboxylic ethers on neuromuscular conduction.]** *Farmakol. Toksikol. (Moscow)* 38(3): 298-303; 1975. (18 references) (Russian)

Active cholinesterase inhibition in cats by armine or the compound GT-165 (*O,O*-dimethyl-*S*-(β-(arylmethylamino) ethyl)thiophosphate methylsulfomethylate) potentiates by ten- and one hundred-fold the blocking action of subecholine and its derivatives on neuromuscular conduction. Dipyroxime (2-5 mg/kg), a cholinesterase reactivator, rapidly lifts the conduction block provoked by muscle relaxants of the subecholine type under cholinesterase inhibition. The subecholine analogue with a single propyl radical at each nitrogen atom blocks neuromuscular conduction when used in doses of 0.1-0.2 γ/kg. It does not display any pressor action. Maximal potentiation of the blocking action exerted by subecholine and its analogs is achieved in the inhibition of acetylcholinesterases as well as pseudocholinesterase.

75-2684. Balazs, T. (Author address not given). **Toxic effects of chemicals in the liver.** *FDA By-Lines* 6(5):291-303; 1975. (5 references)

The principles of hepatic toxicity of chemicals, the pathomechanism of specific toxic effects, and the clinical pathology of chemically induced liver injury in experimental animals are similar to those in man. This article is a discussion of hepatic toxicity. The subcellular structure and related functions of the liver cell are depicted. Ingested chemicals reach the liver in the highest bodily concentrations, particularly via the portal veins. The liver is the main organ of metabolism for both endogenous and foreign substances. Chemicals induce injuries by toxicologic or immunologic mechanisms. Several factors, such as species differences, may influence the sensitivity of the liver to the hepatotoxicity of chemicals. Metabolic hyperfunction, caused by some chemicals, results in liver enlargement. In

some cases the metabolites of the chemicals prove more dangerous than the original chemical. The liver excretory function may be disrupted or there may be degenerative changes in liver tissue, such as fatty liver or necrosis. Numerous chemicals have been shown to produce primary tumors of the liver, originating from the liver cell, bile duct epithelium, or hepatic blood vessels. Specific tests exist for the detection of liver injury due to chemical toxicity. Some of these include assessment of the activity of the smooth endoplasmic reticular enzyme system and examination of the hepatic excretory function by measuring serum or plasma bilirubin or alkaline phosphatase levels, or by the bromosulphthalein test. Liver biopsy still plays a significant role in detection of chemically induced hepatic injury, particularly when other test results are equivocal.

75-2685. De Serres, F. J. (Natl. Inst. Environ. Health Sci., Research Triangle Park, NC) **The impact of short-term tests for mutagenicity of environmental chemicals.** *Genetics* 80(Suppl. 3 part 1): 588-589; 1975.

Even though mutagenically active compounds are known to be present in pesticides, firm data on their actual frequency is lacking. More extensive testing is needed on those pesticides with widespread environmental distribution. Some approach other than tests on whole animals is needed. Short-term tests using microbial assay systems offer a practical solution to the problem of testing hundreds of chemicals rapidly and inexpensively. Positive data obtained in such short-term tests on economically important compounds could be more thoroughly evaluated with further tests on higher organisms in a tier system. With the passage of time a more extensive data base will develop which will enable one to evaluate the general utility of short-term tests in terms of their predictive value for man. Thus, in proposed applications of this newly developed technology, the short-term tests should most properly be considered as assays for potential mutagenic activity in man and as a highly efficient mechanism for both screening large numbers of environmental agents and establishing priorities for further testing in higher organisms.

75-2686. Douch, P. G. C. (Wallaceville Anim. Res. Cent., Private Bag. Upper Hutt, New Zealand). **The metabolism of some thioureidobenzene fungicides in mice and sheep.** *Xenobiotica* 4(8): 457-475; 1974. (22 references)

The metabolism of thiophanate, thiophanate methyl, and related thioureidobenzene compounds has been studied in mice and sheep and in enzyme preparations from these species. Both species catalyze transformation of the thiophanate compounds into the benzimidazole derivatives, ethyl benzimidazol-2-ylcarbamate or methyl benzimidazol-2-ylcarbamate and their 5(6)-hydroxylation products. 2-Aminobenzimidazole and 5-hydroxy-2-aminobenzimidazole are also formed. The *in vitro* metabolism to benzimidazole compounds required NADPH, and was inhibited by SKF 525A and carbon monoxide. The hydroxylated metabolites were excreted from mice and sheep as glucuronide and sulfate conjugates. Benzimidazole derivatives were eliminated as conjugates to an extent of 9—14%. (Author abstract by permission)

75-2687. Maki, A. W.; Geissel, L.; Johnson, H. E. (Dep. Fish. Wildl., Michigan State Univ., East Lansing, MI 48824). **Comparative toxicity of larval lampricide (TFM: 3-trifluoromethyl-4-nitrophenol) to selected benthic macroinvertebrates.** *J. Fish. Res. Board Can.* 32(8): 1455-1459; 1975. (12 references)

The acute toxicity of larval lampricide (TFM: 3-trifluoromethyl-4-nitrophenol) to 35 species of benthic macroinvertebrates was determined in 96 hr flow-through tests. The 96 hr LC50 values range from 2.1 mg/l for blackfly larvae, *Simulium pugetense*, to values in excess of 38.0 mg/l for species with heavy exoskeletons: crayfish (*Orconectes propinquus*), dobsonfly larvae (*Chauloides* sp.), and dragonfly naiads (*Ophiogomphus* sp.). Younger individuals of the clam (*Ligumia* sp.) and the mayfly nymph (*Ephemerella cornuta*) were 2 to 1.5 times more sensitive than larger individuals of the same species. Early emergence of adults and increased locomotor activity were observed among some organisms exposed to sublethal concentrations. (Author abstract by permission)

75-2688. Franchetti, P.; Grifantini, M.; Martelli, S. (Inst. Pharmaceut. Org. Chem, Univ. Camerino, Camerino, Italy). **Structure—activity relationships in reactivators of organophosphorus-inhibited acetylcholinesterase. 9. *N*-heterocyclic acraldoximes methiodides.** *J. Med. Chem.* 18(8): 839-842; 1975. (15 references)

N-heterocyclic acraldoximes methiodides, where the heterocyclic residues are 2-, 3-, and 4-pyridyl, 2-(1-methyl)imidazolyl, or 4-pyrimidyl, were prepared and tested for their reactivating potency on acetylcholinesterase inhibited DFP. The acraldoximes substituted at the beta position with a pyridyl, 2-(1-methyl)imidazolyl, or 4-pyrimidyl residue were prepared by refluxing the corresponding aldehydes with a MeOH solution of NH_2OH-HCl. The compounds exhibited a reactivating activity ranging from 0.35 to 0.61 times that of pralidoxime. The most active was the β-(4-pyrimidyl)acraldoxime. The fact that pralidoxime does not inhibit the enzyme at the concentration used while the acraldoximes methiodides do inhibit the enzyme may be due to lower bond strength with the enzyme surface resulting from van der Waals attractions and hydrophobic bonds.

75-2689. Asakawa, M. (Div. Agric. Chem., Dep. Plant Pathol. Entomol., Natl. Inst. Agric. Sci., Tokyo, Japan). **Insecticide resistance in agricultural insect pests of Japan.** *Jpn. Pestic. Inform.* 23: 5-8; 1975.

In 1974, an Insecticide Resistance Research Team was organized by the Japan Plant Protection Association to investigate the insecticide resistance problem in Japan.

Examples of insecticide resistance occurring between 1965 and 1974 were collected using a questionnaire. Rice leaf beetles and rice leaf miners, which became resistant to BHC and DDT, are now well controlled using other chemicals, as is the rice stem borer, which developed resistance to parathion and BHC. However, malathion-resistant green rice leafhoppers have been reported since 1964 and are becoming increasingly more common each year; some strains are also resistant to diazinon and phenylmethylcarbamate insecticides, although control can be achieved with groups of organophosphates and combinations of organophosphates and carbamates. Although resistance to BHC and malathion has been reported in the brown planthopper, this pest is now presenting few control problems. Organophosphate resistant strains of aphids and lepidopterous insects have been reported throughout the country, but lack of confirmation by scientific investigation suggests that not all such cases actually involve resistance development. Resistant fruit tree, vegetable, and flowering plant mites are frequently reported and may provide serious problems for Japanese agriculture. Resistance to organophosphates and carbaryl has also been reported among some strains of the smaller tea tortorix of apple trees and the apple leaf miner. The Kanzawa spider mite has been reported to be resistant to various organophosphorus pesticides in almost all main tea producing areas. It is concluded that the development of resistance to organophosphates and carbamates among insect pests is a serious problem in Japan.

75-2690. Hama, H. (Div. Entomol., Natl. Inst. Agric. Sci., Tokyo, Japan). **Resistance to insecticides in the green rice leafhopper.** *Jpn. Pestic. Inform.* 25: 9-12; 1975.

Insecticide resistance in the green rice leafhopper, one of the most important paddy field pests, has become a serious problem in Japan. Resistance to the organophosphorus insecticides was first reported in 1961 and has since become widespread. With the substitution of carbamate insecticides for the organophosphorus compounds, the hoppers then became resistant to the former as well as the latter. The resistance to some organophosphorus insecticides in the multiple-resistant hopper is at least partially attributable to a less sensitive cholinesterase, as well as to an increased insecticide degradation activity. The multiple-resistant hopper can be effectively controlled in the field by diazinon, propaphos, acephate, and methomyl, as well as by some combinations of carbamate and organophosphorus insecticides.

75-2691. Iida, W. (Fac. Horticulture, Chiba Univ., Matsudo, Japan). **The tolerance of plant pathogenic fungi and bacteria to fungicides in Japan.** *Jpn. Pestic. Inform.* 23: 13-16; 1975.

Fungicide tolerance among plant pathogenic fungi and bacteria indigenous to Japan is reviewed. Streptomycin tolerance in bacteria has been reported, and many fungi have developed resistance to polyoxin, thiophanate-methyl, benomyl, oxycarboxin, kasugamycin, dinocap, and oxythioquinox. *Pyricularia oryzae* Cav., which is an important plant pathogenic fungus causing rice blast, has become increasingly tolerant to kasugamycin, although edifenphos and IBP have proven effective in controlling resistant strains. Similarly, *Venturia inaequalis*, which causes apple scab, can no longer be controlled with benomyl and thiophanate-methyl, although the resistant isolates seem not to be tolerant to fungicides such as dodine and Spatcide. Fungicides such as zineb, Monox, captafol, and oxine-copper have also been useful in controlling *Alternaria kikuchiana*, which causes black spot of pear and had become resistant to polyoxin. Tolerance to oxycarboxin has been observed in *Puccinia horiana*, which causes chrysanthemum rust, and *Pseudomonas mori*, which causes bacterial blight of the Japanese mulberry, has become resistant to streptomycin. To reduce the emergence of tolerant fungi and bacteria in the field, the alternate or combined application of fungicides with different mechanisms of action is recommended. When tolerant isolates do emerge, fungicide applications should be stopped or use made of other fungicides with different mechanisms of action.

75-2692. Ueda, M. (Sumitomo Chem. Co., Ltd., Tokyo, Japan). **Cremart, new organophosphorus herbicide.** *Jpn. Pestic. Inform* 23: 23-25; 1975.

Cremart (*O*-ethyl -*O*-(3-methyl -6-nitrophenyl) -*N*-*sec*-butyl phosphorothioamidate) is a new preemergence organophosphorus herbicide which can be used to control a broad spectrum of weeds and is safe for many crops. It is heat stable and stable in acidic and neutral solutions. Most annual grasses and many kinds of annual broadleaf weeds are controlled by applications of 1-2.5 kg a.i./ha. The herbicidal effect of this compound is prolonged and enhanced by soil incorporation; remarkable stunting of weeds and crops is caused by overhead spray application. Cremart attacks mainly the meristematic tissues of plants, and inhibits cell division. At high dosage levels, cremart produces toxic symptoms in mammals and fish. These symptoms are similar to those found with most organophosphorus pesticides, which inhibit cholinesterases in vivo. In experimental animals it has not caused symptoms of allergy, irritations, or delayed neurotoxicity, and it was not teratogenic and had no effect on reproduction. The half-life of this herbicide in the soil varies from 16 days in silty loam soil under submerged conditions to 67 days in sandy loam soil under upland conditions. Cremart is biodegradable and unlikely to leave any persistent residues in mammals. Cremart, added to a nutrient solution, was incorporated into bean seedlings over a period of 10 days; most of the chemical was incorporated into the roots and very little was found in the leaves or stems.

75-2693. Tolstova, Yu. S.; Sukhoruchenko, G. I.; Ionova, Z. A. (All-Union Inst. Plant Protection, USSR). **Primenenie trikhogrammy s sovemennymi khimicheskimi i**

biologicheskimi preparatami. [The use of *Trichogramma* with modern chemical and biological preparations.] *Khim. Sel. Khoz.* 12(1): 32-35; 1974. (23 references) (Russian)

The toxicity of different pesticides, such as parathion, malathion, lindane, endrin, diazinon, phenylmercury acetate, DDT, and metasystox to *Trichogramma evanescens* Westw. and *Tr. embryophagum* Htg. was studied to determine the optimal conditions for combined application of pesticides, biological preparations, and *Trichogramma* in pest control. *Trichogramma* was found to be highly susceptible to pesticides even in concentrations substantially below those commonly used in practice. Therefore, integrated pest control systems, including *Trichogramma* should not include broad-spectrum insecticides with high initial and residual toxicity, such as carbaryl, phthalophos, and rogor. Selective preparations of those with short-term toxic effect, such as phosalone and trichlorfon should be used. *Trichogramma* was found to be susceptible to entobacterin, both in pure form and in mixtures with small amounts of trichlorfon, carbaryl, and rogor (dimethoate). The findings indicate that insecticides and entobacterin can not be used simultaneousy with *Trichogramma*.

75-2694. Molochnikov, V. V.; Talanov, G. A. (All-Union Sci. Res. Inst. Dairy Ind., USSR). **Vydelenie TKhM-3 s molokom korov. [Trichlorometaphos excretion in cow milk.]** *Khim. Sel. Khoz.* 12(10): 786-788; 1974. (4 references) (Russian)

The dynamics of the excretion of trichlorometaphos (ronnel)-containing preparation trolene in cow's milk was studied in two cows. The animals were fed a single dose of the preparation (5 g or 12.5 mg/kg) in vegetable oil. The residue analyses were carried out using a gas chromatograph with an electron capture detector or thermionic detector. Trichlorometaphos was found in milk for 80 hr, and trolene was present for 40 hr after administration. The trichlorometaphos concentration in the milk was highest, at 0.026 mg/kg, after 32 hr. Four metabolites of trichlorometaphos and trolene, two of which were tentatively identified as *O*-methyl-2,4,5-trichlorophenylthiophosphoric acid and *O*-ethyl-2,4,5-trichlorophenylthiophosphoric acid, were found for up to 112 hr. The findings indicate that the ingestion of trichlorometaphos-contaminated fodder represents no contamination hazards for milk.

75-2695. Committee Auditing New Pesticides. (Agric. Chem. Inspect. Stn., Min. Agric. Forestry, Kodaira, Tokyo, Japan). **[Recently registered new agricultural chemicals: introduction.]** *Kongetsu No Noyaku (Agric. Chem. Mon.)* 19(9): 76-80; 1975. (Japanese)

Diuron herbicide contains 7% of 1-(α,α-dimethylbenzyl)-3-(*p*-tolyl) urea. It has an acute oral LD50 (a.i.) of more than 1.4 and 4 gm/kg respectively in mouse and rat with TLm (48 hr) for carp larger than 300 ppm. Benoxazole-simetryne herbicide, containing 1.5% of simetryne and 5% of 2-(2-chlorobenzylthio)-5-propyl-1,3,4-oxadiazole, has an acute oral LD50 (a.i.) based on the last ingredient of 1270 and 1030 mg/kg in male and female mouse and 2780 and 2860 mg/kg in male and female rat, with TLm (48 hr) for carp 1.72 ppm.

75-2696. Hameed, S. F.; Adlakha, R. L.; Giamzo, S. P. (Entomol. Res. Stn., Kulu, India). **Relative toxicity of some insecticides to the workers of *Apis mellifera* L.** *Madras Agric. J.* 60(7): 552-556; 1973. (15 references)

The relative toxicity of some systemic and contact insecticides to the adult workers of *Apis mellifera* by nectar poisoning on cut flowers of mustard was investigated. Out of 10 insecticides tested against the bees, fenitrothion, methyldemeton, phosphamidon, phosalone, dimethoate, vamidothion, and carbaryl proved to be more toxic than formothion; they were 10.544, 7.853, 4.909, 2.630, 2.606, 1.303 and 1.262 times, respectively, as toxic. The remaining two insecticides, endosulfan and menazon, were the least toxic.

75-2697. Deichmann, W. B. (Univ. Miami, Sch. Med., Coral Gables, FL 33124). **Study of the ecology of pesticides.** *Nat. Tech. Inform. Serv. PB* 240,. 173, 1974, 56 p.

Mean survival of male mice fed dieldrin (0.3 and 10 ppm) for a lifetime ranged from 12.0 to 13.3 months; for females, 18.6 to 21.8 months. There was an increase in liver weights and a nonsignificant increase in the ratio of liver to body weight in both sexes fed 10 ppm. The number of mice with benign tumors was essentially the same in the 3 groups: controls, those fed 3 ppm, and those fed 10 ppm dieldrin. Compared with controls, however, the number of malignant tumors in all mice decreased as the feeding levels of dieldrin increased. Recalculation of data from an earlier aldrin-dieldrin-endrin study confirmed that there were no statistically significant differences in tumor incidence between control and experimental rats. A second rat feeding experiment with aldrin was conducted with 2 strains of weanling female rats, Osborne-Mendel and Sprague-Dawley. Based on incidence of all tumors in these female rats fed aldrin at 0, 20, and 50 ppm in their diets, the incidence of tumors was neither increased nor decreased by aldrin. It will require completion of the microscopic studies to determine whether the feeding of aldrin altered the distribution of benign and malignant tumors. In the third study, Swiss-Webster mice were fed aldrin (5 and 10 ppm) and DDT (100 ppm) for 7 generations. As the generations progressed, particularly from F3 on, conception was frequently delayed from 3 to 4 weeks. No other signs of toxicity were noted. When sacrified at age 260 days, total body lipids in the F1 generations of all groups showed statistically significant increases when compared with the respective parent (P) generations. In subsequent generations, total body lipids showed no specific trend with the exception of mice fed aldrin 10 ppm, in which total body lipids remained elevated for generations F1 to F6. In all generations the pesticide concentrations in abdominal fat were essentially the same as the pesticide concentrations

in total body lipids, except in mice of the P generation fed DDT 100 ppm, in which the concentrations of total DDT in abdominal fat were approximately twice the concentration in the lipids of the total body. All experimental mice showed a significant increase in both concentration and total retention of dieldrin or total DDT in the carcass of the second generation F4 when compared with the P generation. Feeding of the pesticide-free diet to all experimental mice of the F4 generation resulted in the complete excretion of the pesticides absorbed by these animals while in utero and with their mothers' milk. Resumption of the feeding of the experimental diets by generation F5 and F6 resulted in markedly elevated body pesticide retention and in markedly increased concentration of pesticides (dieldrin or DDT plus metabolites) in the total body lipids and to some further increases in concentration or retention in the F6 generation.

75-2698. Watenabe, I. (Fac. Agric., Iwate Univ., Morioka, Iwate, Japan). [**Degradation of pentachlorophenol in soil. Part 2. Changes in populations of PCP-degrading microorganisms and PCP-resistant microorganisms where PCP has been repeatedly applied.**] *Nippon Dojo-Hiryogaku Zasshi (J. Sci. Soil Anim. Fert. Jpn.)* 46(8): 343-348; 1975. (7 references) (Japanese)

Pentachlorophenol (PCP) was applied once a year to the soil of experimental fields. The numbers of bacteria, of PCP-resistant microorganisms, and of PCP-degrading microorganisms, and the activity for degrading PCP were investigated for two years after the beginning of application. In the first year, an increase in PCP-resistant microorganisms was noted 2 weeks after application; however, the level returned to that in the control field 6 weeks after application, when PCP was almost dissipated. In the second year, the number of PCP-resistant microorganisms showed higher levels even 9 months after PCP application. The question of whether microorganisms which can decompose PCP in experimental liquid cultures are relevant to degradation of PCP in field soil has not yet been resolved. There was no great difference in the decomposition of PCP added to soil specimens to which PCP had been repeatedly applied and to the soil specimens to which PCP had not been applied. It is also questionable whether there are "stable" microorganisms which do not increase upon repeated application of PCP and still are able to decompose PCP.

75-2699. Shida, T.; Homma, Y.; Misato, T. (Cent. Res. Inst., Ajinomoto Co., Ltd., Kawasaki, Kanagawa, Japan). [**Studies on the control of plant diseases by amino acid derivatives. Part VI. Absorption, translocation and degradation of *N*-lauroyl-L-valine in plants.**] *Nippon Nogeikagaku Kaishi (J. Agric. Chem. Soc. Jpn.)* 49(8): 409-415; 1975.

Absorption, translocation and metabolism in rice and cucumber plants of the pesticide, *N*-lauroyl-L-valine, were studied using ^{14}C(*N*-lauroyl)-*N*-lauroyl-L-valine. The findings revealed that the pesticide applied on rice plants and fruits of cucumber is easily washed off within 15 and 1 min, respectively. The pesticide penetrated into healthy leaves of rice and cucumber plants slowly from the injured parts of leaves and fruits, then translocated upward and downward in the case of leaves. When homogenates of rice plants and cucumber fruits were incubated with radiolabeled *N*-lauroyl-L-valine, the formation of ^{14}C-carbon dioxide was recognized.

75-2700. Mukuno, K.; Ishikawa, S. (Sch. Ophthalmol., Fac. Med., Kitasato Univ., Sagamihara, Kanagawa, Japan). [**On toxic ocular diseases, especially the mode of toxic action on the visual system.**] *No To Shinkei (Brain Nerve)* 27(8): 809-920; 1975. (56 references) (Japanese)

A detailed description of toxic ocular diseases and the modes of chronic action of toxic substances, including organophosphorus pesticides (OP), on visual systems is given. Demonstrations by 2 yr administration, p.o., of ethylthiometon to beagles suggest that chronic intoxication by OPs could be summarized as optico-autonomic (sensory) peripheral neuropathy. The findings of axonal denaturation indicate that the mechanism of action of OPs consists of: inhibition of protein synthesis in axons and repression of axoplasmic flow; effects on vessels; and inhibition of cholinesterase in the medullary sheath, as well as a change in composition of fatty acids. Due to the rarity of regeneration of the medullary sheath in the optic nerve, the changes, except for the proliferation of glia, could not be reversed.

75-2701. Otsuka, S. (Section Plant Protect., Min. Agric. Forestry, Tokyo, Japan). [**Plant protection and pesticide news, pesticides: amitoraz EC, orthobencarb herbicide, and oxadiazon combined fertilizer.**] *Nogyo To Engei (Agric. Hortic.)* 50(9): 1171-1172; 1975. (Japanese)

Upon the introduction of three newly registered pesticides, their mammalian and fish toxicities were reported. Amitoraz EC (containing 20% 3-methyl-1,5-bis (2,4,-xylyl)-1,3,5 - triazapentane-1,4-diene) had an acute oral LD50 for mouse of 1460 (male) and 1420 (female) kg/kg. The corresponding values for rat were 600 (male) and 570 (female) mg/kg; acute s.c. LD50 for mouse greater than 2250, for rat greater than 2250 mg/kg. TLm (48 hr) for carp: 0.56 ppm (EC), 1.17 ppm (technical). Orthobencarb herbicide (containing 50% *S*-(2-chlorobenzyl) *N*,*N*-diethylthiocarbamate): acute oral LD50 for mouse 1000 mg/kg. TLm (48 hr) for carp 3.4 ppm. Oxadiazon combined fertilizer (containing 0.35% of 5-*tert*-butyl - 3(2,4-dichloro - 5 -isopropoxyphenyl) - 1,3,4-oxazoline-2-one) showed acute oral LD50 for rat and mouse greater than 8000 mg/kg; TLm (48 hr) 3.2 ppm for carp.

75-2702. Igarashi, H.; Uchiyama, M.; Sato, R. (Biochem. Lab., Central Inst., Nissan Chem. Co., Ltd.,

Shiraoka, Saitama, Japan). [**Studies on the metabolic degradation of pentachloronitrobenzene (PCNB). Part 2. Absorption, accumulation, and metabolism of PCNB by several fungi.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 88-89; 1975. (Japanese)

In the process of studying the metabolism of pentachloronitrobenzene (PCNB) in plants and soil, some unknown metabolites were detected. To elucidate the mechanism of formation, ^{14}C-PCNB was incubated individually with 4 species of phytopathogenic fungi, including some resistant to PCNB and *Trichoderma lignorum* grown in culture at 26°C for 242 hrs. After extracting the culture (filtrate with ether and mycelium with 80% methanol) and purifying the reactant, it was found that the resistant fungus, *Fusarium oxysporum f. lycopersici*, metabolized PCNB to pentachloroaniline, pentachlorothioanisole, and 2 unknown metabolites (UK1 and UK3). The major metabolite was UK1. It was further found that the amount of PCNB absorbed, adsorbed, and accumulated in the mycelia of susceptible fungi was 2-3 times that in the mycelia of resistant fungi, and the metabolic activity of fungi resistant to PCNB was generally higher than the susceptible fungi. Although *T. lignorum* absorbed, adsorbed, and accumulated larger amounts of PCNB, its metabolic activity was generally low.

75-2703. Kanauchi, M.; Yamane, F.; Hashimoto, K. (Nippon Noyaku Co., Ltd., Tokyo, Japan). [**Synthesis and metabolism of ^{14}C-isothioate in plants and animals.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 95-96; 1975. (Japanese)

Synthesis of (^{14}C-methyl)-isothioate, *O,O*-dimethyl *S*-isopropylthioethyl - phosphorodithioate, and its metabolism in mouse and in cabbage were described. After p.o. administration of labeled isothioate (specific activity 4.32 ci/mol) the excretion of ^{14}C in the urine, feces, and expired air, and the distribution of ^{14}C in several organs were traced at intervals. Isothioate was rapidly metabolized: 95% was excreted from the body within 24 hrs. The distribution in the liver, blood, kidney, brain, and fat was respectively 8, 3.5, 1.6, 2, and 0.2% of the administered dose after 1-2 hrs. The major metabolites were *O,O*-dimethyl phosphorodithioic acid and *O,O*-dimethyl phosphoric acid, and were found mainly in the urine. The benzene-extractable part of isothioate absorbed by the root of cabbage decreased to 20 and 5%, respectively, at 2 and 8 days after treatment. The residue consisted of isothioate sulfoxide and isothioate sulfone, with a small amount of unchanged isothioate. The water soluble part in the plant consisted mainly of *O,O*-dimethyl phosphorodithioic acid and *O,O*-dimethyl phosphoric acid.

75-2704. Decallonne, J. R.; Genot, M.; Meyer, J. A. (Lab. Phytopathol. Mycol. Gen., Univ. Cathol. Louvain, Heverlee, Belgium). **Effects of benomyl, carbendazim and thiophanates on respiration and oxidative phosphorylation of *Fusarium oxysporum* and *Saccharomyces cerevisiae*.** *Pestic. Sci.* 6(2): 113-120; 1975. (19 references)

Benomyl (350 X 1 μM) decreased the respiration rate of *Fusarium oxysporum* conidia by 50% during germination. This inhibition was maintained at least 24 hr after treatment had begun. The treatment did not modify the relation between incubation time and respiration rate. Carbendazim, thiabendazole, thiophanate and thiophanate-methyl were assayed using isolated mitochondria of *Saccharomyces cerevisiae*. (Author abstract by permission)

75-2705. Pachecka, J.; Biczowa, B.; Sulinski, A.; Bicz, W. (Dep. Metabol., Inst. Biofarm., Acad. Med., Warsaw, Poland). **Wplyw fosforoorganinicznych srodkow owadobojczych na oddychanie i glikolize osrodkowego ukladu nerwowego szczura i kury w badaniach in vitro.** [**The effect of some organophosphate insecticides on the respiration and glycolytic activities of the central nervous system of rat and hen in vitro.**] *Roczn. Panst. Zakl. Hig.* 26(3): 347-356; 1975. (14 references) (Polish)

The effect of DDVP (dichlorvos; *O,O*-dimethyl - *O*[2,2-dichlorovinyl phosphate) and dipterex (trichlorfon; *O,O*-dimethyl - 2,2,2-trichloro -1- hydroxyethyl phosphonate) on glucose consumption, oxygen uptake, and lactate production by rat and hen brain homogenates was investigated. DDVP (2.7 μmoles/cm^3 and 5.4 μmoles/cm^3) produced 20% and 40% inhibitions of oxygen uptake by rat brain homogenates. In concentrations of 0.54-5.4 μmoles/cm^3, DDVP was observed to inhibit respiration in hen brain homogenates. Inhibition of oxygen consumption was caused by dipterex (5.1 μmoles/cm^3). No effect on respiration of hen brain homogenates was observed with equal quantities. The lowest concentrations of the pesticides studied had no effect on these processes. DDVP and dipterex did not affect glycolytic activity measured as lactate production and glucose uptake.

75-2706. Sitkiewicz, D.; Konecka, A. M.; Skonieczna, M.; Sliwinska, W. (Dep. Metab., Inst. Biofarm., Acad. Med., Warsaw, Poland). **Wplyw insektycydow fosforoorganicznych na utlenianie bursztynianu i akytwnosc oksydazy cytochromowej watroby szczura.** [**The effect of organophosphate insecticides on the succinate oxidation and cytochrome oxidase activity of rat liver.**] *Roczn. Panst. Zakl. Hig.* 26(3): 357-364; 1975. (15 references) (Polish)

The effect of the organophosphate insecticides dipterex (trichlorfon) and DDVP (dichlorvos) on oxygen consumption by rat liver homogenates and the activity of succinate dehydrogenase and cytochrome oxidase is reported. A rat liver mitochondrial fraction was used for the investigation. Dipterex in a range of concentrations from .00039 to 3.9 μ-moles/mg protein had no effect on the respiration of the homogenates in the presence of succinate or the activity of both enzymes in the mitochondrial fraction at time 0 (without preincubation). After preliminary incubation with insecticides, inhibition of succinate oxidation and cytochrome oxidase activity was observed. Inhibition of respiration of liver homogenates increased

during preincubation, reaching a maximum after 1 hr. Cytochrome oxidase activity reached maximum inhibition after a 15 min preincubation and remained stable during a preincubation period of 15 to 45 min. Without preliminary preincubation, inhibition of respiration with succinate as the substrate and of cytochrome oxidase and succinate dehydrogenase in the presence of DDVP was noted.

75-2707. Wojcik, J. (Dep. Commun. Hig., Natl. Inst. Hig., Warsaw, Poland). **Wpływ foschloru w wodzie do picia na narzady wewnetrzne trzech kolejnych pokolen szczurow.** [**The effect of foschlor present in drinking water on the organs of three rat generations.**] *Roczn. Panst. Zakl. Hig.* 26(3): 383-391; 1975. (17 references) (Polish)

Three generations of white rats were given aqueous solutions of foschlor (trichlorfon) at dosages of 0.6, 6.0 and 60.0 mg/kg/24 hr. The animals were weighed after the experiment and their internal organs were weighed after autopsy. Morphological and histochemical aspects of the liver and adrenals were examined in detail. In second and third generation animals, 17-ketosteroids were determined in 24 hr urine. Reduced 17-ketosteroid excretion is indicative of anatomically evident hepatic lesions and functional adrenal damage. No increase in the intensity of changes was observed in each successive generation, except for the spleen, which showed a significant weight rise in the third generation (28% in relation to controls).

75-2708. Ranke-Rybicka, B. (Dep. Commun. Hig., Natl. Inst. Hig., Warsaw, Poland). **Wpływ pestycydow fosforoorganichzynch (malation, foschlor, dichlorfos) na organizmy wodne.** [**The effect of organophosphate pesticides (malathion, foschlor, dichlorvos) on aquatic organisms.**] *Roczn. Panst. Zakl. Hig.* 26(3): 393-399; 1975. (16 references) (Polish)

The effects of the organophosphate pesticides malathion, foschlor (trichlorfon), and dichlorvos in water on oxygen uptake by the fish *Lebistes reticulatus* L. were studied. Warburg's type VA 01 respirometer was used to determine oxygen consumption. Pesticide concentrations of 2.0, 2.6, 3.9, 4.4, 5.7, 7.4, 9.6 and 12.5 mg/l were used. Reduced oxygen utilization in the respiratory process resulted from pesticide application. At a concentration of 2.6 mg/l, malathion inhibited oxygen uptake after 30 min. A 4.3 mg/l foschlor concentration produced similar results, and oxygen uptake was inhibited by dichlorvos after 60 min in a concentration of 2.0 mg/l.

75-2709. Pandey, K. K.; Rai. O. P. (Dep. Bot., Univ. Gorakhpur, India). **Effect of 2,4-dinitrophenol on growth performance of some penicillia.** *Sci. Culture* 41(4): 180-181; 1975. (10 references)

The effect of 2,4-D on mycelial dry weight and total nitrogen content of five soil penicillia was investigated. There was a gradual decrease in mycelial dry weight and total nitrogen content in *P. chrysogenum*, *P. notatum*, *P. rubrum*, and *P. frequentans* with an increase in concentrations of 2,4-D. With *P. terrestre* an increase in mycelial dry weight and total nitrogen content was observed up to 25 ppm, with a decrease at lower concentrations. Concentrations of 750 and 100 ppm were detrimental for *P. rubrum* and no growth was recorded. Higher concentrations of 2,4-D were detrimental for growth of *P. terrestre*.

75-2710. Anonymous. [**A new herbicide, Bentazon (Basagran).**] *Shoku Cho (Plant Contr.)* 9(3): 31-34; 1975. (Japanese)

The herbicide Basagran (bentazon), containing 10% 3-isopropyl-2,1,3- benzothiadiazinon-(4)-2,2- dioxide as a granular formulation or 50% a.i. as a wettable powder, has been introduced. Its mammalian toxicity values are acute LD50 p.o. 1100 mg/kg in rat, 1130 mg/kg in mouse; acute LD50 s.c. > 2500 mg/kg in rat. Its toxicity to aquatic animals is determined as: TLm (48 hr) for carp > 100 ppm, TLm (48 hr) for loach > 100 ppm, and TLm (3 hr) for daphnia > ppm. When absorbed via the root, stem and leaves of graminaceous plants, it is rapidly inactivated.

75-2711. Suzuki, S.; Oikawa, H. (Iwate Prefect. Sericult. Exp. Stn., Iwate, Japan). [**Toxicity of thuricide microbial pesticide to silkworm.**] *Tohoku Nogyo Kenkyu (Tohoku Agric. Res.)* 16: 316-318; 1975. (9 references) (Japanese)

Toxicity to silkworms was compared for four microbial pesticide formulations made from *Bacillus thuringiensis*, three of which contain living bacteria and one of which contains killed spores. Their persistence on mulberry leaves was assessed. Diluted formulations were painted onto mulberry leaves and the leaves were fed to silkworms at the beginning of the third instar for 7 days. From the mortality of the worms it was found that all four formulations showed very strong toxicity to silkworms between the second and the third instar; LD50 (-log) was in the 5.55-6.15 range. The concentration of the four formulations at which no inhibition of development of the worms was observed was 10 ppb. Mortality of 100% remained until 20 days; residual toxicity of the formulations on mulberry leaves was observed to persist for 35-37 days after application, and toxicity to silkworms disappeared 50 days after application.

75-2712. Reiter, O. W.; Talens, G. M.; Woolley, D. E. (Dep. Environ. Toxicol. and Anim. Physiol., Univ. California, Davis, CA 95616). **Parathion administration in the monkey: time course of inhibition and recovery of blood cholinesterases and visual discrimination performance.** *Toxicol. Appl. Pharmacol.* 33(1): 1-13; 1975. (22 references)

The effects of parathion [*O,O*-diethyl *O*-*p*-nitrophenyl phosphorothioate] administration on activities of acetylcholinesterase (AChE) in blood and pseudocholinesterase (ChE) in plasma were studied in bonnet (*Macaca radiata*) and rhesus (*M. mulatta*) monkeys. In addition, the effect of parathion administration on

performance of learned visual discrimination tasks were studied in rhesus monkeys. Peak inhibition of AChE and ChE occurred about 6 hr after administration of 0.5, 1.0, and 2.0 mg/kg parathion po. The degree of peak inhibition was greater for ChE than for AChE, was dose-related for both enzymes, and was of about the same magnitude in both species, even though control values for AChE and ChE differed in the two species. Activities of both enzymes returned to control values within 2 wk at all dose levels. Administration of 2.0, 1.5, and 1.0 mg/kg parathion abolished performance of the learned tasks 5 hr later and for as long as 3-7 days. When performance of the tasks returned after the 2.0 mg/kg dose, the level of performance remained below pretreatment values for up to 3 wk. A dose of 0.5 mg/kg did not affect performance. Comparison of the present findings with other work showed that reversal of blood AChE and ChE inhibition after parathion administration occurred more rapidly in monkey than in man but required more time in monkey than in mouse. It was observed that scopolamine and methyl scopolamine also blocked visual discrimination performance. (Author abstract by permission)

75-2713. Chow, A. Y. K.; Murphy, S. D. (Dep. Physiol., Kresge Cent. Environ. Health, Harvard Sch. Public Heath, Boston, MA 02115). **Propanil (3,4-dichloropropionanilide)-induced methemoglobin formation in relation to its metabolism in vitro.** *Toxicol. Appl. Pharmacol.* 33(1): 14-20; 1975. (12 references)

Propanil (1.83 mmol/kg, ip) produced about 50% methemoglobin in male mice and rats while male guinea pigs were resistant to methemoglobinemia. A sex difference in the methemoglobinemic response to propanil was observed only in mice; the males were more sensitive than the females. An equimolar dose of 3,4-dichloroaniline (DCA), a hydrolytic metabolite of propanil, produced highest methemoglobin values in rats, followed by mice and relatively low values in guinea pigs. There was no sex difference in response to DCA. Of nine tissues assayed for the hydrolysis of propanil by the enzyme, acylamidase, only liver and kidney showed detectable activity. In all three species, acylamidase activity in the liver was higher than that in the kidney. Male mice had significantly higher liver and kidney acylamidase activity than females, which may explain the sex difference in propanil-induced methemoglobinemia in this species. Male rats had lower liver and kidney acylamidase activity than male mice in spite of the approximately equal susceptibility to methemoglobin production by propanil in these two species. A lower erythrocyte methemoglobin reductase activity coupled with a less active liver metabolism of DCA to a methemoglobin-forming metabolite in male rats as compared to male mice could account for the apparent discrepancies. The resistance of guinea pigs to propanil-induced methemoglobinemia could not be explained by differences in these metabolic reactions. Some evidence was obtained which suggests that reduced rates of absorption coupled with different modes of metabolism or disposition of DCA in guinea pigs may contribute to their resistance. (Author abstract by permission)

75-2714. Byard, J. L.; Koepke, U. C.; Abraham, R.; Goldberg, L.; Coulston, F. (Dep. Environ. Toxicol., Cent. Exp. Pathol. Toxicol, Albany Med. Coll., Union Univ., Albany, NY 12208). **Biochemical changes in the liver of mice fed mirex.** *Toxicol. Appl. Pharmacol.* 33(1): 70-77; 1975. (24 references)

In a study of the hepatic effects of mirex (dodecachloroctahydro - 1,3,4 - methano - 2H - cyclobuta[cd]pentalene), male Charles River CD-1 mice were fed 1-90 ppm mirex in the diet for periods ranging from 1 to 70 wk. At regular intervals, heavy mitochondrial, light mitochondrial, microsomal, and soluble fractions were prepared from livers of three to six animals per group. Measurements of relative liver weight, DNA, protein, respiration, respiratory control, mitochondrial membrane permeability, mixed function oxidases (*N*-demethylation, aromatic hydroxylation, and cytochrome P-450), glucose-6-phosphatase, diene conjugates, and protein binding were carried out. Mirex caused an increase in relative liver weight, total liver DNA, total protein in each liver fraction, mitochondrial respiration and coupling, and mixed function oxidases. Except for DNA, each parameter increased with an increase in the liver of mirex in the diet and the duration of feeding. DNA was stimulated at all doses to 130-150% of control levels. A further rise in DNA occurred during the onset of the development of liver nodules. The action of mirex on mitochondria occurred predominantly in the light mitochondrial fraction and resulted in a stimulation of respiration, increased coupling and a decrease in membrane permeability. Mirex added to control mitochondria in vitro produced none of these changes. Glucose-6-phosphatase activity was decreased with increasing levels of mirex in the diet and duration of feeding. The concentration of microsomal diene conjugates was not affected by mirex. Mirex was firmly bound to soluble liver proteins both in vivo and in vitro, but did not displace cortisol from the cortisol receptor protein. (Author abstract by permission).

75-2715. Bedford, C. T.; Hutson, D. H.; Natoff, I. L. (Tunstall Lab., Sittingbourne Res. Cent., Shell Res. Ltd., Sittingbourne, Kent, England). **The acute toxicity of endrin and its metabolites to rats.** *Toxicol. Appl. Pharmacol.* 33(1): 115-121; 1975. (7 references)

The acute oral LD50 values based on 10-day mortalities for endrin and three of its mammalian metabolites, *anti*-12-hydroxyendrin, *syn*-12-hydroxyendrin, and 12-ketoendrin, have been measured in rats. The metabolites were all more toxic than the parent insecticide. LD50 values, rapidity of intoxication, sex differences, and analysis of the brain of rats dosed with the various compounds indicated that 12-ketoendrin may be the acute toxicant in each case. Thus the oxidative metabolism of endrin, while being responsible for the known relatively

efficient elimination from rats of subacute doses of this pesticide, may also be responsible for its acute toxicity. (Author abstract by permission)

75-2716. Smith, F. A.; Schwetz, B. A.; Gehring, P. J. (Toxicol. Res. Lab., Health Environ. Res., Dow Chemical U.S.A., Midland, MI). **Teratogenicity of 2,3,7,8 - tetrachlorodibenzo-*p* - dioxin in CF-1 mice.** *Toxicol. Appl. Pharmacol.* 33(1): 124; 1975.

The effect of TCDD (2,3,7,8-tetrachlorodibenzo - *p* - dioxin) on the developing embryo and fetus of CF-1 mice has been evaluated. An experimental no-adverse-effect level for TCDD in the developing embryo and fetus of mice is postulated. Pregnant CF-1 mice were given TCDD by oral gavage on days 6-15 of gestation at dose levels of 0, 0.001, 0.01, 0.1, 1.0 and 3.0 μg/kg/day. Little or no maternal toxicity was observed at any dose level. Cleft palate and dilated renal pelvis were found at 3.0 μg/kg/day. No malformations were found at the intermediate dose levels of 0.1 or 0.01 μg/kg/day. At the lowest or 0.001-μg/kg/day dose level, exencephalies were found. Whether these latter observations were due to chance rather than treatment with TCDD is now under investigation. If this observation is not duplicated in further studies, the experimental nonteratogenic dose level of TCDD in CF-1 mice appears to be 0.1 μg/kg/day. (Author abstract by permission, Abstracts of Papers for the Fourteenth Annual Meeting of the Society of Toxicology, Williamsburg, Virginia, March 9-13, 1975. Abstract No. 6.)

75-2717. Byard, J. L.; Pittman, K. A. (Dep. Environ. Toxicol., Univ. California, Davis, CA). **Early liver changes produced by mirex and their reversibility.** *Toxicol. Appl. Pharmacol.* 33(1): 130; 1975.

The reversibility of early liver changes produced by a brief exposure to mirex was measured to determine if any irreversible changes might occur which could be related to the later development of liver nodules. Male Charles River CD-1 mice were fed 60 ppm mirex in the diet for 2 wk and then continued on the same diet containing no mirex. Mice were sacrificed at intervals and body weight, liver weight, and the concentrations of RNA, DNA, and cytochrome P-450 in the liver were measured. Samples of liver, fat, and plasma were taken for analysis of mirex. The body weights of treated mice were not different from those of controls throughout the experiment. Gross examination revealed that, up to 4 mo, livers of treated mice were enlarged but otherwise were not different from control mice. The liver weight of treated animals doubled after 2 wk of feeding mirex, declined gradually thereafter, and was still somewhat elevated at 4 mo. The total amount of cytochrome P-450 was elevated within 2 days after feeding mirex, reached a maximum increase of six times the control amount at 2 wk, and was still three times the control amount at 4 mo. The concentration of RNA and DNA in the liver declined to a minimum as liver weight increased to a maximum. However, at the same time, total RNA and DNA increased to about 150% of the control values. By 2 mo, the increase in total RNA had partially regressed but still remained higher than control values. The increase in DNA did not appear to have regressed. Analysis of mirex in the plasma indicated a rapid rise to a maximum of 5.5 μg/ml at 2 wk, then a rapid fall to 1.6 μg/ml at 3 wk, followed by a gradual decline to 0.4 μg/ml at 2 mo. Analyses of mirex in liver and fat are in progress. The data available at this time indicate that the measured parameters of liver growth, except for DNA, are partially reversible and are directly related to the concentration of mirex in the plasma. Additional studies are in progress to test the relationship between the apparent irreversible increase in DNA and the later development of liver nodules. (Author abstract by permission, Abstract No. 20).

75-2718. Fulfs, J. C.; Abraham, R.; Coulston, F. (Inst. Comp. and Human Toxicol., Albany Med. Coll., Albany, NY). **Comparative ultrastructural and cytochemical studies in livers of mice, rats, and monkeys fed various levels of mirex.** *Toxicol. Appl. Pharmacol.* 33(1): 130-131; 1975.

Mirex was fed at levels of 1 and 5 ppm to mice, 5 ppm to rats, while monkeys received 20 ppm in their diets. Mice and rats were killed, and their livers obtained at 2, 6, and 12 mo. Monkey livers were obtained by surgical biopsies at 3, 6, 12, and 18 mo. Cytochemical techniques were employed to detect activities of lysosomal β-glycerol-phosphate (ACpase) and glucose 6-phosphates (G-6-pase). ACpase and G-6-pase remained unchanged and comparable to controls in livers of mice receiving 1 ppm. G-6-pase decreased in centrilobular areas while ACpase increased in time in the 5 ppm group. At 12 mo, liver cells that lost their G-6-pase activity were surronded by Kupffer cells that contained strong ACpase. In contrast, rat livers demonstrated no increases in ACpase and only a marginal loss in G-6-pase. Surprisingly, and in spite of high levels of mirex ingested, monkey livers showed no loss of G-6-pase or activation of ACpase. Ultrastructurally, the underlying feature in all livers was proliferation of smooth endoplasmic reticulum (SER), displaying species variation. Thus, in mice, intense proliferation of SER that was both time and dose dependent was localized in specific regions of the cytosol. Hepatic cells, damaged and necrotic in mice fed 5 ppm, were phagocytosed by activated Kupffer cells. SER proliferation in rat liver cells was less conspicuous than in mice and in monkeys; the nature of this change was diversified, occupying the entire hepatic cell. Except for this change, rat and monkey liver cells were normal. These studies emphasize species and enzyme variations in responses to mirex. An interesting aspect observed was the lack of lysosomal catabolism in liver enlargement. (Author abstract by permission, Abstract No. 21)

75-2719. Rose, M. S.; Smith, L. L.; Wyatt, I. (Biochem. Mechanisms Unit, Imperial Chem. Ind. Ltd, Cent. Toxicol. Lab., Alderley Park, Macclesfield, Chesire, England). **The accumulation of paraquat by the lung and the**

relevance of this to the treatment of paraquat poisoning. *Toxicol. Appl. Pharmacol.* 33(1): 136; 1975.

Paraquat and diquat are bipyridilium herbicides which have similar chemical structures and chemical properties. They have the same intravenous LD50 values but, whereas paraquat-poisoned rats die with extensive lung damage, diquat-poisoned rats do not develop lung damage. After oral administration, paraquat is accumulated by the lung whereas diquat is not. An energy-dependent accumulation process in slices of rat lung has been demonstrated which is selective for paraquat. It has been shown that other tissues from rats do not accumulate paraquat in vitro to the same extent as the lung. Lung tissues from other species, including man, have also been shown to accumulate paraquat in vitro. The accumulation of paraquat by slices of rat lung is inhibited by a variety of compounds including histamine, 5-hydroxytryptamine, and noradrenaline. It is concluded that paraquat might be accumulated into lung tissue by a system which normally removes these compounds from the circulation. Less toxic derivatives of these amines have been investigated as possible antidotes to paraquat poisoning. (Author abstract by permission, Abstract No. 35)

75-2720. Hook, G. E. R.; Fowler, B. B.; Orton, T. C.; Lucier, G. W. (Pharmacol. Branch and Environ Toxicol. Branch, Natl. Inst. Environ. Health Sci., Res. Triangle Park NC). **Stimulation and suppression of hepatic and extrahepatic microsomal mixed-function oxidases (MFOs) by 2,3,7,8-tetrachlorodibenzo - *p* - dioxin (TCDD).** *Toxicol. Appl. Pharmacol.* 33(1): 138; 1975.

TCDD is one of the most toxic compounds known to man. The ability of TCDD to alter hepatic microsomal MFOs, although perhaps unrelated directly to the toxic action of the compound, is without precedent as far as dose-response relationships are concerned and indicates that the ingestion of minute amounts of TCDD could radically alter the metabolism of other simultaneously ingested foreign compounds such as drugs or chemicals of environmental origin. The response of microsomal MFOs following oral ingestion of TCDD was investigated in both hepatic and extrahepatic tissues of the rat, rabbit, and guinea pig. Cytochrome P-450 concentrations and benzpyrene hydroxylase activities were increased in rat liver microsomes by oral doses of less than 1 μg TCDD/kg. However, *N*-demethylase and testosterone 2β-and 16α-hydroxylase activities of hepatic microsomes from male rats were suppressed. The stimulating effect of TCDD on rat hepatic microsomes was considerably more persistent than the suppressive effect. Following a single oral dose of only 25 μg TCDD/kg, benzpyrene hydroxylase of male rat liver microsomes remained significantly elevated after 73 days but the suppression of benzphetamine *N*-demethylase had gone by 35 days. In microsomes from extrahepatic tissues of the rat, MFO stimulation by TCDD occurred only in the kidney. However, UDP-glucuronyl transferase was increased in microsomes from the lung, kidney, intestine, and brain but not testes. The response of the rabbit and guinea pig to TCDD differed considerably from that of the rat. Benzpyrene by droxylase was unaffected in hepatic microsomes from guinea pig and suppressed in microsomes from rabbit liver. Benzphetamine *N*-demethylase was also suppressed in rabbit liver microsomes. The only pulmonary microsomal MFO responsive to TCDD was biphenyl 4-hydroxylase of the rabbit and guinea pig. Suppression of MFO activity was not observed in any of the extrahepatic tissues studied and may be confined to only certain hepatic systems. The results indicate that the most dramatic TCDD effects on microsomal MFOs are limited to the liver and kidney. (Author abstract by permission, Abstract No. 39)

75-2721. Groblewski, G. E.; Vitorovic, S. L.; Ngatia, J.; Wills, J. H.; Coulston, F. (Inst. Comp. and Human Toxicol., Albany Med. Coll., Albany, NY). **The effects of fenthion and some of its metabolites on enzymic functional activities in the cat.** *Toxicol. Appl. Pharmacol.* 33(1): 139; 1975.

The intrinsic potencies of the organophosphorus insecticide, fenthion, and three of its principal metabolites were compared using relatively modest doses of the substances in the cat. These compounds had been studied by intraperitoneal injection into the rat of large fractions of the LD50 doses by DuBois and Kinoshita (*Toxicol. Appl. Pharmacol.* 6, 86-95, 1974). In vivo, fenthion sulfone was about twice as inhibitory to ChE of the cat's liver as oxofenthion and nearly four times as active as fenthion and fenthion sulfoxide. Fenthion and its sulfone and sulfoxide were more actively inhibitory of ChE of the liver than of its triacetinesterase (TACE). Oxofenthion seemed to be the most potent inhibitor of the ChE's of the blood, skeletal muscle, auricular cardiac muscle, and brain stem, whereas fenthion seemed to be the most potent inhibitor of ChE in ventricular cardiac muscle. None of the four compounds in i.v. doses up to 10 mg/kg, or up to 12 mg/kg for fenthion, had a significant effect on neuromuscular transmission, ventilatory activity, the length of the PR interval of the ECG, or the duration of the QRS complex. Fenthion may have reduced slightly the heart rate and the blood pressure; the other three compounds produced moderate elevations of the blood pressure. Oxofenthion and fenthion sulfone increased the contractile force of the duodenum. All four compounds elevated the threshold voltage for electrical excitation of the inspiratory area of the medulla. Fenthion, the only compound to lower rather than to elevate blood pressure, was the most potent inhibitor of ChE in ventricular muscle. Otherwise, the correlation of functional alterations with ability to inhibit hydrolytic enzymes was not evident in this series of experiments. (Author abstract by permission, Abstract No. 41)

75-2722. Krieger, R. I.; Gee, S. J.; Miller, J. L.; Thonginthusak, T. (Dep. Environ. Toxicol., Univ. California, Davis, CA). **Aldrin epoxidase and dihydroisodrin hydroxylase in hepatic needle biopsy specimens: assay and properties.** *Toxicol. Appl. Pharmacol.* 33(1): 140; 1975.

Aldrin and dihydroisodrin are chlorinated cyclodienes that are metabolized by hepatic microsomal mixed-function oxidases. The substrates and their respective metabolites, dieldrin and monohydroxy dihydroisodrin, are relatively stable, can be easily extracted from aqueous media using hexane, and are analyzed in picogram quantities using electron capture gas chromatography. Using 0.2 ml incubation media containing a glucose-6-phosphate NADPH-generating system, parameters such as substrate concentration, time, cofactors, and enzyme concentration have been evaluated. *Macaca mulata, M. radiata,* and white rat hepatic needle biopsy specimens from mature males have been used. When 4-min incubation periods are used with protein levels (*M. radiata*) between 1 and 8 mg the apparent *Km* and *V* for the epoxidase is 1.4×10^5 M and 214 pmol/mg/min and for the hydroxylase 2.3×10^5 M and 151 pmol/mg/min, respectively. The levels of each are elevated by microsomal enzyme inducers such as phenobarbital and DDT. Aldrin epoxidation and dihydroisodrin hydroxylation can be studied in needle biopsy specimens, and they can provide a readily obtained measure of hepatic oxidative activity. (Author abstract by permission, Abstract No. 43)

75-2723. Brown, H. R.; Sharma, R. P. (Toxicol. Program, Utah State Univ., Logan UT). **Inhibition of neural membrane adenosinetriphosphatases by organophosphates.** *Toxicol. Appl. Pharmacol.* 33(1): 140; 1975.

The delayed neurotoxicity of organophosphorus compounds has not been satisfactorily explained on the basis of inhibition of cholinesterases. The critical role of Na+, K+-stimulated Mg^2+-dependent ATPase in maintaining energy metabolism and its location within neuronal membranes coupled with reports indicating inhibition of certain ATPase by DFP suggest the possible involvement of ATPase in the observed neurotoxic paralysis. Tri-*o*-tolyl phosphate (TOTP) and mevinphos were examined for time dependent inhibition of ATPase. These compounds inhibited not only the Na+, K+-stimulated enzyme but also the ouabain-insensitive Mg^2+-dependent activity of ATPase in a synaptosomal fraction from chicken spinal cord. Inhibition curves obtained from these experiments indicate the inhibition process to occur in an exponential fashion following an initial drop. The bimolecular inhibiton constants, affinity constants, and binding constants were determined from the log-linear portion of the curves. A comparison of these constants with those found for inhibition of acetylcholinesterase revealed the inhibitory potential of mevinphos to be several orders of magnitute greater for cholinesterase. On the other hand TOTP, which is not a direct inhibitor of cholinesterases and is a well-known neurotoxic organophosphate, inhibited ATPase at a much lower concentration as compared to mevinphos. The inhibition of Mg^2+-dependent ATPase by TOTP was potentiated by addition of Ca^2+. Interference in the ability of affected neurons to respond to their energy requirements as a result of inhibition of various ATPases appears to provide a possible explanation for TOTP neurotoxicity. (Author abstract by permission, Abstract No. 44)

75-2724. Van Gelder, G. A.; Cunningham, W. L. (Behavioral Toxicol. Lab., Coll. Vet. Med., Iowa State Univ., Ames, IA). **The effect of low-level dieldrin exposure on the EEG and learning ability of the squirrel monkey.** *Toxicol. Appl. Pharmacol.* 33(1): 142; 1975.

Dieldrin, a persistent chlorinated hydrocarbon insecticide, acts as a neurotoxicant. Two studies examined the effects of subclinical exposure on acquisition of a nonspatial successive discrimination reversal task and on onset of dieldrin-related EEG alterations in adult male squirrel monkeys. The first study used a reversal criterion of 15 consecutive correct responses. A 0.1 mg/kg group (N = 3) group achieved significantly fewer reversals than either 0.01 mg/kg) (N= 4) or control (N= 3) groups over a 55-day exposure period. Subsequent exposure termination and increase to 0.1 mg/kg, for 54 days, did not affect performance in the high and low groups, respectively. The second study recorded four nonexposed EEG's from each of another nine monkeys before exposure began for 60 days at three levels: 0.1 mg/kg (N = 3), 0.01 mg/kg (N = 3), and no exposure (N = 3). EEG recordings were taken 4 and 24 hr postdosing on days 10, 30, 50, and 20, 40, 60, respectively. High amplitude (200-300 μV), slow waves (4-6 Hz) occurred more often in the 4-hr recording condition. Most changes occurred on day 50 in both exposure groups. No dieldrin-related EEG changes occurred in the control group. Together, continuous daily 0.1 mg/kg exposure impaired acquistion and altered the EEG in about the same time frame. Also, continuous exposure at 0.01 mg/kg, below the threshold for enzyme induction (0.05-0.1 mg/kg), altered the EEG. Preliminary data from a third study indicate that 1 yr accumulated 0.01 mg/kg exposure slows acquisition, relative to the rate of acquisition at that level in the first study. (Author abstract by permission, Abstract No. 50)

75-2725. Ecobichon, D. J.; Myatt, G. L.; Greenhalgh, R. (Dep. Pharmacol. Dalhousie Univ., Halifax, Canada). **Mammalian toxicity and degradation of fenitrooxon and *S*-methyl fenitrooxon.** *Toxicol. Appl. Pharmacol.* 33(1): 143-144; 1975.

Commercial fenitrothion [*O,O*-dimethyl-*O*-(3-methyl-4-nitrophenyl) -phosphorothioate] is known to be contaminated by an inherent impurity, *S*-methyl fenitrooxon [*O,O*-dimethyl-*O*-(3-methyl-4-nitrophenyl)- phosphorothioate], in a quantity depending on purity of starting materials and production processes. In vitro inhibition studies of mammalian plasma pseudocholinesterase and erythrocyte and eel tissue acetylcholinesterase revealed comparable I50 values for *S*-methyl fenitrooxon and fenitrooxon. The LD50 (ip) values in male CD mice were 112 and 44.5 mg/kg for the *S*-methyl isomer was evidenced by rapid spontaneous hydrolysis in aqueous buffer and extremely rapid enzymatic hydrolysis by plasma and hepatic arylesterases of the mouse, rat, guinea pig, and rabbit, compared to the hydrolysis rate of fenitrooxon. (Author abstract by permission, abridged, Abstract No. 53.)

75-2726. Hansell, M. M.; Ecobichon, D. J. (Dep. Anat. Pharmacol., Dalhousie Univ., Halifax, Nova Scotia, Canada). **The morphological effects of maternally administered phenobarbital and DDT on hepatic cell structure in young rats.** *Toxicol. Appl. Pharmacol.* 33(1): 144; 1975.

The purpose of this study was to determine when, during the period of perinatal development, the liver would respond to a xenobiotic inducing agent. Hepatocytes of rat pups at various stages of pre- and postnatal development, receiving either phenobarbital (PB) or DDT transplacentally or via the milk, were examined for morphological alternations and changes in activitives of drug-metabolizing enzymes. PB (75 mg/kg/day for 3 days) or DDT (50 mg/kg/day for 3 days) were administered orally via a feeding needle and syringe to pregnant or lactating dams, the pups being killed 24 hr after the last dose, at 3 days prepartum, at term, and at 4, 7, 14, 21, and 28 days of age. Samples of liver were fixed and embedded for light and electron microscopy and the remaining tissue was used for measurement of enzyme levels. Enzymatic studies showed no significant induction prior to birth, although chemical analysis identified the presence of residues in fetal tissues. No morphological differences were observed in hepatocytes from experimental and control smooth endoplasmic reticulum, lipid inclusions and microbodies, morphological alterations which are associated with increased drug metabolism. Myelin whorls were observed in 4-day-old pups. These changes could be correlated with induction of hepatic mixed function oxidases (*O*-demethylase). The alterations resulting from DDT treatment were generally greater than those resulting from PB treatment. (Author abstract by permission, Abstract No. 54)

75-2727. Gallo, M. A. (Rhodia Inc., Somerset, NJ). **Studies on the toxicity of phosalone.** *Toxicol. Appl. Pharmacol.* 33(1): 144; 1975.

Phosalone (*S*-[6- chloro-3- (mercaptomethyl) -2-benzoxazolinone] *O,O*-diethyl phosphoro dithioate) is the active ingredient in the insecticide Zolone. Experiments were conducted to determine the acute and chronic toxicity of the compound to rats and dogs and to investigate percutaneous absorption in young pigs. The acute oral LD50 of phosalone in rodents is approximately 100 mg/kg and the dermal LD50 is 1500 mg/kg or greater depending on the formulation employed. The oral and dermal LD50 of the oxygen analog in rats is 35 mg/kg and 400 mg/kg, respectively. Percutaneous absorption studies in young pigs indicate only a slight translocation of the ^{14}C-labeled material, which may account for the marked differences between the oral and dermal toxicity. Feeding phosalone to rats at dietary concentrations of 25, 50, and 250 ppm and to dogs at 100, 200 and 1000 ppm resulted in dose dependent inhibition of RBC and plasma cholinesterase with an apparent level of no observable effect at 50 ppm. Brain cholinesterase was inhibited 40% at 1000 ppm in the dogs but little or no inhibition was observed in rat brain at any dietary concentration. No other signs of cholinergy were observed. The results of these experiments indicate that phosalone is less toxic than many other widely used organophosphates. (Author abstract by permission, Abstract No. 55)

75-2728. Yang, R. S. H.; Pittman, K. A. (Inst. Comp. Human Toxicol., Albany Med. Coll., Albany, NY). **Fate of [^{14}C]hexachlorobenzene in the rhesus monkey and the rat.** *Toxicol. Appl. Pharmacol.* 33(1): 147; 1975.

A study of the comparative metabolism of HCB has been initiated in several mammalian species, including the rhesus monkey. To assess the possible loss of [^{14}C]HCB and $^{14}CO_2$ in the expired air, each of two male rats was injected iv with approximately 1.3 μCi of [^{14}C]HCB (13.4 μCi/mg) and was held in a closed-metabolic system for 48 hr. The level of radioactivity was determined on urine, feces, various tissues, and the contents in different traps for moisture, volatile chemicals, and CO_2. The results indicated that little or no radioactivity was recovered from feces and urine, respectively. Fat contained the highest amount of radioactivity, followed by adrenal gland. The radioactivity found in the other tissues was about 1/30 of that of fat. To study the disposition of [^{14}C]HCB in rhesus monkeys, a female monkey (4.9 kg) was injected iv with 24.7 μCi of [^{14}C]HCB and was held in a metabolic cage for 100 days prior to sacrifice. Radioactivity in plasma, feces, and urine was measured at various intervals throughout the experiment. There was a rapid decline of plasma radioactivity in the first 6 hr after the injection followed by a second phase of slow decline. Approximately 17.1 and 1.8% of the administered radioactivity was excreted in feces and urine, respectively. Of some 30 tissues analyzed for radioactivity, fat contained the highest activity followed by adrenal gland and other tissues. Two additional monkeys have been under study along similar lines for up to 8 mo. (Author abstract by permission, Abstract No. 63)

75-2729. Yang, R. S. H. (Inst. Comp. and Human Toxicol., Albany Med. Coll., Albany, NY). **Species-specific binding of ^{14}C-hexachlorobenzene to animal blood cells.** *Toxicol. Appl. Pharmacol.* 33(1): 147-148; 1975.

In the course of comparative metabolic studies of [^{14}C]hexachlorobenzene (^{14}C-HCB) in mammalian species, it was observed that, in the rat, the level of radioactivity in whole blood was about six times greater than in plasma; this was not the case in monkey. In vitro experiments showed that human blood behaved similarly to that of the monkey. These findings suggest that there is a species-specific binding of [^{14}C]HCB to erythrocytes and possibly other cells in animal blood. A comparative study was conducted to examine the in vitro binding of [^{14}C]-HCB with blood cells of some 16 species of animals. [^{14}C]HCB was bound to blood cells of rats, mice, and rabbits; there was little or no binding in the case of other species: human, monkey, pig, cow, horse, donkey, sheep, goat, dog, guinea pig, hamster, turkey, and chicken. In the case of the rat, there is rapid binding of [^{14}C]HCB, clearly

associated with erythrocytes. The bound radioactivity can be removed by toluene extraction but not by dialysis or repeated washing with saline. (Author abstract by permission, Abstract No. 64)

75-2730. Beatty, P. W.; Neal, R. A. (Cent. Environ. Toxicol., Dep. Biochem., Vanderbilt Univ. Sch. of Med., Nashville, TN). **Effect of alteration of hepatic mixed function oxidase activity on the toxicity of 2,3,7,8-tetrachlorodibenzodioxin (TCDD) to rats.** *Toxicol. Appl. Pharmacol.* 33(1): 151; 1975.

TCDD, a contaminant of various products involving the use of the polychlorinated phenols, is one of the most toxic synthetic chemicals yet discovered. In spite of an extensive general knowledge of the toxicity of TCDD to a number of animal species, the mechanism by which it exerts its lethal effects is not yet known. It is also not clear whether the parent compound or some metabolite is responsible for the toxic effects seen. A possible metabolite or metabolites which may be responsible for the toxicity of this compound is an epoxide or a phenol resulting from the mixed function oxidase catalyzed metabolism of TCDD. If a mixed function oxidase catalyzed product or products is responsible for the toxicity of TCDD, it would appear possible that an increase in the activity of the mixed function oxidase enzyme system might increase the toxicity of TCDD. In these studies, we have altered the activity of the hepatic mixed function oxidase enzymes in weanling male, adult male, and adult female rats by administration of inducing agents or by castration of adult male rats, and examined the effect of these treatments on the toxicity of TCDD. The results of these studies have indicated that pretreatment of weanling rats with phenobarbital, a treatment which increases the activity of the hepatic mixed function enzyme system, decreases the toxicity of TCDD as compared to untreated controls. In addition, castration of adult male rats, a treatment which decreases the activity of the mixed function oxidase enzyme system, increases the toxicity of TCDD in comparison to noncastrated controls. Similar effects have been observed in female rats in which the activity of the mixed function oxidase enzymes have been increased by pretreatment with testosterone or phenobarbital. The results of these studies imply that an increase in mixed function oxidase activity is associated with a decreased toxicity of TCDD. Further, these data imply that the parent form of TCDD is the more toxic compound and that metabolism by the mixed function oxidase enzyme system results in a less toxic metabolite. (Author abstract by permission, Abstract No. 73)

75-2731. Miller, J. L.; Krieger, R. I.; Rorvik, M.; Ruebner, B.; Gee, S. J.; Thongsinthusak, T. (Dep. Environ. Toxicol. and Med. Pathol., Univ. California, Davis, CA). **Assessment of hepatic mixed-function oxidase induction in rhesus monkeys using in vivo, in vitro and histological parameters.** *Toxicol. Appl. Pharmacol.* 33(1): 153; 1975.

The exposure of our population to a diversity of environmental chemicals may result in the altered ability of the hepatic microsomal mixed-function oxidase (MFO) system to metabolize lipophilic compounds. The development of rapid and sensitive in vivo parameters to quantitate MFO activity will facilitate assessment of the hepatic effects of foreign chemicals. [^{14}C]Antipyrene plasma half-lives (APH) were determined in rhesus monkeys after exposure to ethanol, phenobarbital and *p,p'*-DDT. Needle biopsies provided liver tissue for characterization of ultrastructural changes using light and electron microscopy. Rhesus monkeys, tube-fed 100 calories/kg of a liquid diet based on casein in which 41% of the calories were derived from grain alcohol, showed an 18% decrease in APH. Control animals fed the same diet containing isocaloric amounts of glucose showed no significant change. Transient changes in liver ultrastructure were observed. In another study, treatment of these animals with 15 mg/kg phenobarbital twice daily for 4 days resulted in a 36% decrease in APH which was associated with a marked proliferation of liver endoplasmic reticulum. Urinary cortisol: 6βhydroxycortisol ratios were not significantly elevated following phenobarbital treatment.

75-2732. Kuiper-Goodman, T.; Grant, D. L.; Moodie, C. A.; Korsrud, G.; Munro, I. C. (Natl. Health and Welfare, Health Protect. Branch, Ottawa, Ontario, Canada). **Subacute toxicity of hexachlorobenzene in the rat.** *Toxicol. Appl. Pharmacol.* 33(1): 157; 1975.

Hexachlorobenzene (HCB) is a persistent fungicide and industrial contaminant which has been used for over 25 yr. There have been several reports of HCB residues in man, cattle, poultry, and wildlife and not enough is known about the toxicity of this compound. Therefore, 700 male and female rats of the Charles River (COBS) strain were fed a diet consisting of Master Fox cubes with 4% corn oil to which was added HCB to give 0, 0.5, 2, 8, or 32 mg/kg body wt. Groups of four rats of both sexes were killed at 21, 42, 62, 89, and 104 days of feeding and at various times after feeding with HCB was discontinued. Residues of HCB reached a plateau before 104 days and were dose related, with concentrations in adipose tissue > liver > brain > serum. At the two highest dose levels relative liver weight was increased in both sexes. Pathological examination showed that mainly the liver was affected, with acentrilobular increase in hepatocyte size due to proliferated smooth endoplasmic reticulum. This was correlated to increased activities of drug metabolizing enzymes, which persisted long after the animals were on a HCB-free diet. Females developed porphyria, with high porphyrin concentrations persisting after the rats were placed on a HCB-free diet. Pathological examination of the other organs indicated no changes with the possible exception of the kidney. (Author abstract by permission, Abstract No. 87)

75-2733. Schein, L. G.; Thomas, J. A. (Dep. Pharmacol, West Virginia Univ. Med. Cent., Morgantown, WV).

Parathion-dieldrin interactions on androgen metabolism in the mouse. *Toxicol. Appl. Pharmacol.* 33(1): 157; 1975.

Previous studies have revealed that dieldrin can interfere with androgen metabolism (*Toxicol. Appl. Pharmacol.* 26, 523, 1973), but that parathion exerts little effect upon male sex hormone levels (*Toxicol. Appl. Pharmacol.* 29, 53, 1974). The present studies reveal that dieldrin (2.5 mg/kg daily × 5 or 10, po) and parathion (2.6 mg/kg daily × 5 or 10, po) can interact so as to cause even greater disturbances in testosterone dynamics in mouse prostate glands. The most pronounced inhibitory effect upon the in vivo assimilation of [^{3}H]testosterone by the prostate gland occurred when parathion was administered for 5 days followed by a similar treatment period with dieldrin. The total radiosteroid concentrations detected in the prostate glands of mice receiving the aforementioned dose sequence of pesticides were decreased 54%. Hepatic microsomes, like the prostate glands, revealed significant reductions in [^{3}H]testosterone concentrations following the simultaneous administration of dieldrin and parathion. These findings reveal that organochlorine and organophosphate pesticides can interact and produce exaggerated biological changes in the male reproductive system. (Author abstract by permission, Abstract No. 88)

75-2734. Koeferl, M. T.; Larson, R. E. (Dep. Pharmacol. Toxicol., Oregon State Univ., Corvallis, OR). **Effect of low dietary levels of DDT on acute CCl_4 hepatotoxicity in rats.** *Toxicol. Appl. Pharmacol.* 33(1): 157-158; 1975.

Acute pretreatment of rats with DDT has been shown to potentiate acute CCl_4-induced hepatotoxicity. The present investigation was undertaken to quantify the DDT-CCl_4 interaction from the standpoint of a chronic dietary exposure to DDT, and to compare acute and chronic pretreatments. Rats fed 6-65 ppm for 3 wk and 65 ppm for 24 wk attained body burdens of DDT and its metabolites ranging from 6.1 to 30.6 ppm, compared to 0 ppm for controls. In the acute study rats were treated with 35-150 mg DDT/kg po 24 hr prior to CCl_4 exposure. If all of the 35 mg/kg dose were absorbed, it would represent a total body burden of 35 ppm and would be comparable to a chronic exposure of 65 ppm for 24 wk. CCl_4 was administered by gavage at dosages of 0.125-1.0 mg/kg. A potentiation of serum transaminase (SGPT and SGOT) responses to CCl_4 was noted in all groups pretreated with DDT. This potentiation effect was dose-related, both to CCl_4 and to the total body burden or dose of DDT. CCl_4-induced BSP retention was also greatly enhanced following prior dietary exposure to DDT. The onset and development of potentiated hepatic dysfunction paralleled that of parenchymal cell destruction. All results were confirmed by histopathology. About 75% of the induced cytochrome F-450 concentration in DDT-fed rats was destroyed within 6 hr after CCl_4, at which time the onset of potentiation was noted. Hepatic regeneration was impaired in DDT-fed rats, since the P-450 concentration continued to decline between 24 and 48 hr after CCl_4. The amount of P-450 destruction appeared to correlate with the degree of hepatic damage observed. More P-450 was destroyed in DDT-fed rats as a result of the induced microsomal concentration of the cytochrome present initially before CCl_4 was given. The CCl_4-P-450 interaction could play on integral role in the potentiation phenomenon, as McLean and McLean (1969) have suggested. Since rats and man respond similarly to CCl_4, these results indicate that man's chronic exposure to DDT could render him highly susceptible to a secondary exposure to CCl_4. (Author abstract by permission, Abstract No. 89)

75-2735. Hoffman, D. G.; Emmerson, J. L.; Morton, D. M. (Toxicol. Div., Lilly Res. Lab., Greenfield, IN). **Dose- and age-dependent metabolic disposition of the herbicide 1-(5-*tert*-butyl-1,3,4-thiadiazol-2-yl)-1,3-dimethylurea in the rat.** *Toxicol. Appl. Pharmacol.* 33(1): 158; 1975.

As an extension of previously reported studies the metabolic disposition of 1-(5-tert-butyl-1,3,4-thiadiazol-2-yl)-1,3-dimethylurea (EL-103) was investigated at doses employed in chronic toxicity studies. [^{14}C]EL-103 was administered by gavage to young (2 mo) and old (15-18 mo) male rats. After solvent extraction, plasma and urine metabolites were separated by TLC and quantified by scintillation counting. In young rats the apparent half life for plasma ^{214}C was 4 and 20 hr after doses of 10 and 60 mg/kg, respectively. The major circulating metabolism were the 3-hydroxymethyl-, 3-desmethyl-, and 1,3-didesmethyl compounds. The relative proportions of the three circulating metabolites were not affected by dose. Approximately 85% of a 10-mg/kg dose was excreted in the urine of both young and old rats within 24 hr. Young rats excreted 40, 80, and 82% of a 160-mg/kg dose in 24, 48, and 72 hr, respectively, while old rats excreted 20, 62, and 86% of the dose during the same time periods. The pattern of urinary metabolites was similar in young and old rats given 10 mg/kg but that pattern differed slightly from the one obtained from rats of either age given 160 mg/kg. The major urinary metabolites were hydroxylated as well as demethylated. Dose appears to have had more effect than the age of the animal on the metabolic disposition of EL-103. (Author abstract by permission, Abstract No. 90).

75-2736. Highman, B.; Gaines, T. B.; Schumacher, H. J. (Univ. Arkansas Sch. Med., Little Rock, AR). **Sequential histopathologic changes induced in mice by a technical and a purified preparation of 2,4,5-trichlorophenoxyacetic acid.** *Toxicol. Appl. Pharmacol.* 33(1): 161; 1975.

Maternal mice given 4-8 doses of 120 mg/kg of a technical preparation containing 97.9% 2,4,5-T often developed myocardial lesions, hypocellularity of the bone marrow, and lymphocyte depletion in thymus, spleen, or lymph nodes. To assess effects of such maternal health impairment on the fetus, 474 dihybrid mice received po 0, 60, or 120 mg/kg of 2,4,5-T (technical or purified) on 9 csuccessive days beginning 6 days after mating. All mice given 60 mg/kg and some given 120 mg/kg of 2,4,5-T appeared normal at sacrifice and showed little or no pathological changes. Mice suscepti-

ble to 120 mg/kg became ill or moribund after 1-8 doses and few survived 11 days; 34 of 66 moribund mice given technical 2,4,5-T and 23 of 31 given purified 2,4,5-T showed myocardial lesions among others. Thus the lesions were primarily due to 2,4,5-T itself rather than to impurities in product. (Author abstract by permission, abridged, Abstract No. 98.)

75-2737. Green, S.; Moreland, F. S. (Food and Drug Adm., Washington, DC). **Cytogenetic evaluation of several dioxins in the rat.** *Toxicol. Appl. Pharmacol.* 33(1): 161; 1975.

Cytogenetic investigations were performed with three dioxins to determine what potential these substances have for producing chromosomal aberrations in the bone marrow of male rats. The substances investigated were 2,3,7,8- tetrachlorodibenzo -*p*- dioxin (TCDD), 2,7-dichlorodibenzo -*p*- dioxin (DCDD), and dibenzo-*p*-dioxin (DD). In the first study, the three compounds were dissolved in DMSO and were administered by intubation at 10 μg/kg each day for a 5-day period. All rats were sacrificed 6 hr after the last administration. Colchicine was injected ip at 2 mg/kg 2 hr before sacrifice. No significant increases in chromosomal aberrations were observed. The second study was restricted to TCDD, the most potent of the compounds. TCDD in an anisole corn oil solvent (1.5% v/v) was administered to rats ip at 5, 10, or 15 μg/kg. One group received TCDD orally at 20 μg/kg. The positive control substance, triethylenemelamine (TEM), was administered ip at 0.375 mg/kg. The following groups were sacrificed 24 hr after injection: positive control, 20 μg/kg, and 15 μg/kg. The remaining groups were sacrificed 29 days after injection. Microscopic examination of the slides revealed no evidence of chromosomal aberrations in any of the dioxin-treated groups. The group administered TEM showed a statistically significant increase in abnormalities over the control. Accordingly, with the treatment regimen employed in this investigation, TCDD, DCDD and DD appear to possess no potential for producing chromosomal aberrations in the bone marrow of male rats. (Author abstract by permission, Abstract No. 99).

75-2738. Kennedy, M. W.; Pittman, K. A.; Stein, V. M. (Cent. Exp. Pathol. Toxicol., Albany Med. Coll., Albany, NY). **Fate of [^{14}C]Mirex in the femal Rhesus monkey.** *Toxicol. Appl. Pharmacol.* 33(1): 161-162; 1975.

[^{14}C]Mirex (5.23 mCi/mmol) was given iv to female rhesus monkeys 1 and 2 and orally to monkey 3 in a dose of about 1 mg/kg. Blood, plasma, urine, and fecal samples were analyzed for ^{14}C content by oxidation and liquid scintillation counting. Monkey 1 was autopsied 106 days and monkey 3 was autopsied 23 days after receiving [^{14}C]Mirex. Tissue samples were analyzed for ^{14}C content. Monkey 2 is still under study. In the monkeys treated iv, plasma ^{14}C showed a rapid decrease over the first few hours from initial high values. In the monkey treated orally, ^{14}C first appeared in the plasma at 2 hr and reached a maximum at 5 hr. Thereafter the decline in plasma radioactivity paralleled that found in the iv animals. After 2 wk, the rate of decline decreased considerably and ^{14}C could be measured reliably for at least 8 mo. Less than 0.4% of the dose was excreted in the urine in the first week, after which urine collections were discontinued. ^{14}C was present in the feces for at least 8 mo, with a cumulative excretion of < 5%. At autopsy of monkeys 1 and 3, all tissues analyzed contained ^{14}C. The highest concentration of ^{14}C was found in the fat, which was calculated to contain about 90% of the dose. Analysis of fat and feces for the chemical nature of the ^{14}C showed almost all to be present as unchanged Mirex. There was a small amount of a compound more polar than Mirex in the feces, which comprised less than 3% of the fecal radioactivity. Urinary ^{14}C could not be extracted by solvents which extract Mirex. Mirex, given intravenously or orally, rapidly leaves the plasma, primarily going into the fat where it remains for a long period of time. Metabolism plays a minor role in disposition of this compound. (Author abstract by permission, Abstract No. 100)

75-2739. Bradlaw, J. A.; Garthoff, L. H.; Graff, D. M.; Hurley, N. E. (Food and Drug Adm., Washington, DC). **Detection of chlorinated dioxins: induction of aryl hydrocarbon hydroxylase activity in rat hepatoma cell culture.** *Toxicol. Appl. Pharmacol.* 33(1): 166; 1975.

Induction of aryl hydrocarbon hydroxylase (AHH) activity was used to detect low levels of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) and other chlorinated dioxins. Monolayer cultures of Reuber rat hepatoma cells in late log phase of growth were challenged for 48 hr with seven halogenated dibenzo-*p*-dioxins. Homogenized cell extracts from pooled cultures were assayed for AHH activity by the enzymatic conversion of benzo(a)pyrene to 3-hydroxybenzo(a)pyrene as described by Nebert and Gelboin (*J. Biol. Chem.* 243, 6242, 1968). Enzyme activity, expressed as picomoles product formed/milligram of protein/minute at 37°C, was between 10 and 24 in control cell extracts. The assay was linear for enzyme concentration and time under the conditions employed. TCDD was the most potent inducer tested. A threefold induction was produced by 0.5 pmol/culture (161 pg) and maximal induction by 50 pmol/culture of TCDD as compared with control. In comparison, a threefold induction was produced by 1,2,3,4,7,8-hexachloro- and 1,2,3,4,7-pentachlorodibenzo-*p*-dioxin with 5 and 50 pmol/culture, respectively. Little or no induction of AHH activity was observed with 500 pmol/culture of dibenzo-*p*-dioxin, 2,7-dichloro-, 1,3,6,8-tetrachloro-, and 1,2,4,6,7,9-hexachlorodibenzo-*p*-dioxin. With 96 hr exposure to TCDD, a threefold induction of AHH activity was produced by 0.078 pmol/culture (25 pg). The three chlorinated dioxins that induced AHH activity had halogen atoms in at least three of the four lateral ring positions which is consistent with observations reported in chick embryo liver (Poland and Glover, *Mol. Pharmacol.* 9, 736, 1973). However, the cell culture bioassay has potentially greater sensitivity

and may serve as a practical method for the detection of minute amounts of chlorinated dioxins in animal tissues and food samples. (Author abstact by permission, Abstract No. 110)

75-2740. Grant, D. L.; Hatina, G. V.; Phillips, W. E. J. (Bureau Chem. Safety, Food Directorate, Health Protect. Branch, Ottawa, Ontario, Canada). **Effect of hexachlorobenzene on rat reproduction.** *Toxicol. Appl. Pharmacol.* 33(1): 167; 1975.

This study was designed to study the effect of hexachlorobenzene (HCB) on rat reproduction. Dietary concentratios of HCB (0, 10, 20, 40, 80, 160, 320, and 640 ppm) were fed to Sprague-Dawley rats and four generations of rats were raised. Pregnancy (number of dams whelping/number of dams mated), viability (pups surviving 5 days/pups born alive) and lactation (pups weaned/live pups on day 5 less culls) indices were measured. Body weight gains of parents and pups were monitored. HCB residues were measured in the 21-day-old pups of the F_1 a generation. The two highest dietary concentrations were toxic to the F_0 generation and 50 and 20%, respectively, of the females died. Suckling pups were particularly sensitive and many died prior to being weaned. The viability index was zero in the F_1a and F_1b generations for rats fed 320 and 640 ppm HCB and only 55% for the 160 ppm group. The lactation index decreased from 30% for the F_1a and F_1b generation pups to 0% for the F_2a and F_2b generation pups in the 160 ppm group. The lactation index decreased from 93% in the F_1a generation to 40% in the F_3b generation in the 80 ppm group. Body weight gain was affected by treatment. No gross abnormalities were present in pups. Residues were present in the weanling rats in a dose-dependent manner. (Author abstract by permission, Abstract No. 113)

75-2741. Powers, M. B.; Voelker, R. W.; Page, N. P.; Weisburger, E. K.; Kraybill, H. F. (Hazleton Lab., Inc., Vienna, VA). **Carcinogenicity of ethylene dibromide (EDB) and 1,2-dibromo-3-chloropropane (DBCP) after oral administration in rats and mice.** *Toxicol. Appl. Pharmacol.* 33(1): 171-172; 1975.

Lifetime p.o. studies were conducted in Osborne-Mendel rats and hybrid B6C3F_1 mice with various agricultural and industrial chemicals at the maximum tolerated dose and half that dose. Tumor induction was noted as early as 12 wk with EDB (ethylene dibromide) and 10 wk with DBCP (dibromochloropropane). Both chemicals induced a high incidence of metastasizing squamous cell carcinoma of the stomach in rats and mice (in excess of 90 and 70% in EDB-treated rats and mice, respectively; in excess of 60 and 90% in DBCP-treated rats and mice, respectively). DBCP also induced a high incidence (54%) of mammary gland adenocardcinoma in female rats but not in the mice. (Author abstract by permission, abridged, Abstract No. 123).

75-2742. Fowler, B. A.; Hook, G. E. R.; Lucier, G. W. (Natl. Inst. Environ. Health Sci., Research Triangle Park, NC). **Tetrachlorodibenzo-*p*-dioxin induction of renal microsomal enzyme systems.** *Toxicol. Appl. Pharmacol.* 33(1): 176-177; 1975.

The toxicities of many xenobiotics are known to be altered by microsomal drug metabolizing enzyme systems. Knowledge concerning levels of microsomal enzyme activities and the distribution of these enzymes among specific cell types within an organ is essential to an understanding of chemical toxicity. Kidney microsomal drug metabolizing activities are normally low but can be markedly stimulated by administration of tetrachlorodibenzo-*p*-dioxin (TCDD). The current study was designed to measure the level and duration of TCDD induction of renal microsomal systems and to correlate these changes with ultrastructural changes in kidneys of the same animals. Adult male rats were given a single oal dose of 5 μg 2,3,7,8-TCDD by gavage in 0.5 ml acetone-corn oil. Controls were given acetone-corn oil only. Experimental animals plus controls were killed at 18 yr and 3, 7, or 16 days after treatment. Kidneys were excised from each animal and tissue blocks processed for electron microscopy. Renal microsomes were prepared from the same kidneys evaluated by electron microscopy. A massive increase in smooth endoplasmic reticulum (SER) within cells of the pars recta (S_3) segments of the proximal tubules was observed in the kidneys of TCDD-treated animals at 3, 7, and 16 days. Renal microsomal benzpyrene hydroxylase activities in these animals were increased 55-fold at 18 hr while that of glucuronyl transferase was doubled. At all other subsequent time points, the activity of benzpyrene hydroxylase was increased 80-fold and that of glucuronyl transferase 4-fold. These findings suggest that TCDD induction of microsomal enzyme activities occurred primarily within a specific segment of the renal proximal tubule. (Author abstract by permission, Abstract No. 136)

75-2743. Mirer, F. E.; Levine, B. S.; Murphy, S. D. (Dep. Physiol., Harvard Sch. Public Health, Boston, MA). **Effects of piperonyl butoxide and diethyl maleate on toxicity and metabolism of parathion and methyl parathion.** *Toxicol. Appl. Pharmacol.* 33(1): 181; 1975.

Pretreatment with piperonyl butoxide (PB), 400 mg/kg, 1 hr prior to challenge, markedly protected mice against methyl parathion (MPS) toxicity while slightly potentiating the effects of parathion (PS). Activation to paraoxon or methyl paraoxon and oxidative degradation may have been inhibited by PB while detoxification of MPS but not PS proceeded by a glutathione-alkyl transferase pathway (Kamienski and Murphy, *Toxicol. Appl. Pharmacol.* 18, 883, 1971). We confirmed the effect of PB on MPS (LD50>325 mg/kg, ip, in PB-pretreated mice vs. 8.2 mg/kg in control) and PS toxicity. Pretreatment with diethyl maleate (DEM), 1 mg/kg, 1 hr before challenge, depleted liver glutathione and potentiated PS and MPS toxicity. In vivo, DEM potentiated inhibition of brain cholinesterase by PS and MPS, while PB potentiated inhib-

ition by PS and protected aginst inhibition by MPS. To compare metabolism of PS and MPS in vivo, plasma and brain pesticide concentrations were measured after ip challenge of pretreated mice. PB increased brain concentrations of PS 7-fold and MPS 11-fold, and plasma concentrations of MPS and PS 5-fold above control. DEM caused a 2-fold increase in brain concentrations of PS and MPS. PS and MPS activation were measured in incubations with fortified liver homogenates from pretreated animals. PB reduced both activation and degradation of both MPS and PS. DEM caused a large increase in activation of MPS to methyl paraoxon and decreased total degradation. DEM inhibited both activation and degradation of PS. Although the in vitro studies with DEM-pretreated mice support the hypothesis that an active dealkylation pathway for detoxification of MPS exists, in vivo studies do not support this mechanism for the divergent effect of PB pretreatment on MPS and PS toxicity. (Author abstract by permission, Abstract No. 148)

75-2744. Kociba, R. J.; Keeler, P. A.; Park, C. N.; Gehring, P. J. (Toxicol. Res. Lab., Health and Environ. Res., Dow Chemical USA, Midland, MI). **2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD): results of a 13-week oral toxicity study in rats.** *Toxicol. Appl. Pharmacol.* 33(1): 182-183; 1975.

TCDD is highly toxic and occurs as an unwanted contaminant in the herbicide 2,4,5-T. A study was conducted to assess the biologic response of rats given 0, 0.001, 0.01, 0.1, or 1.0 μg 5 days/wk for 13 wk. Doses of 1.0 μg TCDD/kg/day caused mortality, inactivity, decreased body weights and food consumption, icterus, increased serum bilirubin and alkaline phosphatase, degenerative and inflammatory changes in the liver, lymphoid depletion of the thymus and other lymphoid organs, increased urinary excretion of porphyrins and delta-aminolevulinic acid, minimal alterations of some hematopoietic components, and morphological evidence of a functional suppression of the reproductive organs. Doses of 0.1 μg TCDD/kg/day caused lesser degrees of some of the effects seen in the high dose group of rats. In rats given 0.01 or 0.001 μg TCDD/kg/day, all parameters were essentially unaffected, except for a slight increase in the mean liver-to-body weight ratio in rats given 0.01 μg TCDD/kg/day. This slight increase in relative liver weight was not considered of any toxicological significance. These data indicate that no discernible ill effects occurred in rats given 0.01 or 0.001 μg TCDD/kg 5 days/wk for 13 wk. (Author abstract by permission, Abstract No. 151)

75-2745. Rose, J. Q.; Ramsey, J. C.; Wentzler, T. H.; Hummel, R. A.; Gehring, P. J. (The Dow Chemical Company, Midland, MI). **The fate of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) following single or repeated oral doses to rats.** *Toxicol. Appl. Pharmacol.* 33(1): 183; 1975.

2,3,7,8-Tetrachlorodibenzo-*p*-dioxin is a highly toxic compound formed as an unwanted contaminant in the synthesis of 2,4,5-trichlorophenol and found in some samples of the herbicide, 2,4,5-trichlorophenoxyacetic acid (2,4,5-T). Following a single oral dose of 1 μg [^{14}C]TCDD/kg, ^{14}C activity was detected only in feces and the half-life of ^{14}C activity in the body was 30.4 days. Twenty-two days after the single oral dose, liver and fat contained concentrations of ^{14}C activity 10 times greater than any other tissue examined. Following repeated oral doses of 1.0, 0.1, or 0.01 μg [^{14}C]TCDD/kg/day Monday through Friday for 7 wk, the major route of ^{14}C excretion was via the feces with small amounts in the urine. The half-life of ^{14}C activity upon repeated administration was 23 days. Assuming a one compartment open model, 73.8% of the steady state level of ^{14}C activity was achieved in the whole body after 7 wk administration. As concentrations in the tissues approached steady state, concentrations of ^{14}C activity in liver on day 49 were 3.5 times greater than that of fat and 27 times greater than those concentrations achieved in kidney, thymus and spleen. The ^{14}C activity in the liver was identified as TCDD by gas chomatography-mass spectrometry and could be quantitatively extracted with organic solvents. The results of this study indicate that TCDD in the body reaches essentially steady state levels after 90 days of repeated daily exposure and the rate at which steady state levels are achieved is independent of the administered dose for the 1.0-0.01 μg/kg/day dose range. (Author abstract by permission, Abstract No. 152)

75-2746. Statham, C. N.; Lech, J. J. (Dep. Pharmacol., Med. Coll. Wisconsin, Milwaukee, WI). **Synergism of the acute toxic effects of 2,4-D butyl ester, dieldrin, rotenone, and pentachlorophenol in rainbow trout by carbaryl.** *Toxicol. Appl. Pharmacol.* 33(1): 188; 1975.

In static bioassays using fingerling rainbow trout, 1 mg/liter carbaryl (C) decreased the LC50 of 2,4-D butyl ester from 30 to 11 mg/liter. This concentration of C by itself produced no mortality in trout during a 48-hr exposure. Although in vivo studies using plasma and liver extracts from trout exposed to C indicated that esterase activity against 2,4-D butyl ester was decreased by approximately 50%, there was no apparent decrease in the ability of C-treated trout to hydrolyze 2,4-D butyl ester in vivo. When trout were exposed to [^{14}C]2,4-D butyl ester in water, the fish which were preexposed to C accumulated approximately twice the amount of ^{14}C when compared to control fish. Direct analysis of the ^{14}C residues indicated the presence of only the hydrolysis product, 2,4-D acid, in tissues from both control and C-treated trout. Total body washout studies using [^{14}C]2,4-D butyl ester showed that the rate of disappearance of ^{14}C in C-treated fish was not significantly different from control. Enhancement of the toxicity of dieldrin, rotenone, and pentachlorophenol by C in similar experiments indicated that the synergism may be nonspecific. Studies using arecoline (A), a direct acting cholinergic agent, instead of C, showed essentially the same results. The synergism induced by both C and A was blocked by atropine. These studies indicate that both C and A may have increased the toxicities of 2,4-D butyl

ester, dieldrin, rotenone, and pentachlorophenol by a cholinergic mechanism, possibly involving uptake of these latter compounds from water. (Author abstract by permission, Abstract No. 166)

75-2747. Fink, R. J. (Truslow Farms Inc., Chestertown, MD). **The effect of simazine on the reproductive capability of mallard ducks.** *Toxicol. Appl. Pharmacol.* 33(1): 188-189; 1975.

This study was designed to investigate the effect of Simazine (a triazine herbicide) on the reproductive capability of mallard ducks. The birds were exposed to simazine at dietary levels of 2.0 and 20.0 ppm from prior to the onset of egg laying through the normal egg production cycle. Reproductive impairment was evaluated by analysis of the following reproductive parameters: eggs laid, eggshell cracks, viable embryos, live 3-wk embryos, normal hatchlings, 14-day-old survivors, and eggshell thinning. Statistical analysis of the reproductive parameters revealed that simazine caused no reproductive impairment in mallard ducks. (Author abstract by permission, Abstract No. 168)

75-2748. Fink, R. J. (Truslow Farms Inc., Chestertown, MD). **The effect of tricyclohexyltin hydroxide on the reproductive capability of bobwhite quail.** *Toxicol. Appl. Pharmacol.* 33(1): 189; 1975.

This study was designed to investigate the effect of tricyclohexyltin hydroxide on the reproductive capability of bobwhite quail. The birds were exposed to tricycloexyltin hydroxide at dietary levels of 5.0 and 20.0 ppm from prior to the onset of egg laying through the normal egg production cycle. Reproductive impairment was evaluated by analysis of the following reproductive parameters: eggs laid, eggshell cracks, viable embryos, live 3-wk embryos, normal hatchlings, 14-day-old survivors, and eggshell thinning. Statistical analysis of the reproductive parameters revealed that tricyclohexyltin hydroxide caused no reproductive impairment in bobwhite quail. (Author abstract by permission, Abstract No. 169)

75-2749. Chadwick, R. W.; Chuang, L. T.; Williams, K. (EPA, NERC, PTSEL, Research Triangle Park, NC). **Dehydrogenation-a previously unreported pathway of lindane metabolism in mammals.** *Toxicol. Appl. Pharmacol.* 33(1): 193; 1975.

It is generally accepted that the dehydrochlorination of lindane to γ-pentachlorocyclohexane is the primary initial step in the metabolism of lindane by both plants and animals. Nevertheless, the chemical structure of some recently identified lindane metabolites indicated that there might be important metabolic pathways other than the dehydrochlorination of lindane to pentachlorocyclohexane. This study presents evidence for an alternate initial pathway, specifically the dehydrogenation of lindane to the intermediate metabolite hexachlorocyclohexane. Study of the in vitro metabolism of lindane by liver preparations demonstrates that the dehydrogenase system is associated with the microsomal fraction and has a requirement for reduced pyridine nucleotide coenzyme as well as molecular oxygen. Inhibition by SKF-525-A and CO suggest that the enzyme is cytochrome P-450-dependent. Pretreatment of rats with DDT, which stimulates lindane metabolism, also induces significantly higher dehydrogenase activity. Both the in vivo and in vitro metabolism of the hexachlorocyclohexane intermediate produces previously identified lindane metabolites. Results of this study indicate that dehydrogenation is an important initial pathway in the metabolism of lindane by mammals. (Author abstract by permission, Abstract No. 180).

75-2750. Pittman, K. A.; Kennedy, M. W.; Treble, D. H. (Natl. Inst. Environ. Health Sci., Research Triangle Park, NC). **Mirex kinetics in the rhesus monkey.** *Toxicol. Appl. Pharmacol.* 33(1): 196-197; 1975.

This study was done to develop a mathematical model to predict the long-term, kinetic behavior of Mirex in animals. [^{14}C]Mirex was given (1 mg/kg) iv and po to female rhesus monkeys (*Macaca mulatta*). Radioactivity was measured in plasma, urine, and feces at intervals after dosing and in tissues when animals were killed. Mirex was analyzed by gas-liquid chromatography. Resolution of semilog plots of plasma concentration-time curves suggested the presence of four or more kinetically distinguishable compartments and provided estimates of rate constants for distribution and elimination. A BASIC-language program, FITKIN, was used to solve the differential equations comprising the model and to adjust the above estimates to obtain a normalized, least-squares fit. Of several models postulated, a mammillary, four-compartment ("central," "fast," "slow," and "very slow"), open system model, providing for the urinary excretion of Mirex from the "central" compartment and for the fecal excretion of Mirex from the "fast" tissue compartment, yielded theoretical data in excellent agreement with observed values for plasma, urinary, and fecal radioactivity. At autopsy the amount of [^{14}C]Mirex found in the liver corresponded to that predicted for the "fast" compartment, and the proportion of the dose (90%) found in the fat corresponded to the predicted accumulation of Mirex in a "very slow" tissue compartment. The model predicted that the accumulation of Mirex into fat would be retarded by the presence of a "slow" tissue compartment, so that distribution equilibrium would take about half a year. From that time to the end of a 10-yr projection, decline in the quantities of Mirex predicted for all compartments was only 2%, implying an extremely long biological half-life. Plasma analyses will be continued on an iv dosed monkey for at least 1 yr, in order to check these predictions experimentally. (Author abstract by permission, Abstract No. 189)

75-2751. Bus, J. S.; Cagen, X. Z.; Aust, S. D.; Gibson, J. E. (Dep. Pharmacol., Michigan State Univ., East Lansing, MI). **Lipid peroxidation: a possible mechanism for paraquat toxicity.** *Toxicol. Appl. Pharmacol.* 33(1): 197-198; 1975.

The purpose of this study was to determine the role of membrane lipid peroxidation in the in vivo toxicity of the herbicide paraquat. Adult female Swiss-Webster mice were fed diets deficient in the lipid antioxidants selenium (Se) or vitamin E (Vit E) for 5 wk and then examined for sensitivity to paraquat toxicity by determination of the 7 day ip LD50. The paraquat LD50 in control mice fed laboratory animal chow was 30.0 mg/kg. Liver glutathione peroxidase (a Se-dependent enzyme) activity in the Se-deficient mice was 16% of control activity. Vitamin E deficiency was confirmed by the sialuric acid red blood cell hemolysis test, with 86% hemolysis in deficient mice vs. 24% in controls. Administration to control mice of the reduced glutathione (GSH)-depleting agent diethyl maleate at 1.2 ml/kg, 30 min before paraquat treatment also significantly reduced the paraquat LD50 to 9.4 mg/kg. GSH is a substrate for glutathione peroxidase, which detoxifies lipid peroxides formed during membrane lipid peroxidation. Paraquat alone, 30 mg/kg ip, also reduced liver GSH to 68% of controls 24 hr following treatment. In other experiments rats exposed for 3 wk to 100 ppm paraquat in the drinking water had significantly elevated lung glucose-6-phosphate dehydrogenase (G6PD) activity compared to controls (78.2 ± 11.7 vs 47.0 ± 2.0 nmol NADPH oxidized/min/mg protein). G6PD provides reducing equivalents for GSH production and is induced in response to oxidative stress. These data provide in vivo evidence that lipid peroxidation may be involved in paraquat toxicity. (Author abstract by permission, Abstract No. 191)

75-2752. Gabovich, R. D.; Minkh, A. A.; Motuzkov, I. N. (Kiev Med. Inst., Kiev, USSR). **Vliyanie ul'trafioletovoy radiatsii na tolerantnost' organizma k vozdeystviyu khimicheskikh veshchesty. [Effect of ultraviolet radiation on tolerance of the organism to chemical substances.]** *Vestn. Akad. Med. Nauk SSSR* 3: 26-37; 1975.

The effect of artificial UV irradiation on tolerances to chemicals such as BHC, methylmercaptophos, and be benzene was studied on albino rats. The animals were exposed to BHC at 50 mg/m^3 or methyl mercaptophos at 3 mg/m^3 in air for 3 months. Irradiation started 3 weeks before the poisoning test. Irradiation with slightly suberythemal doses resulted in maximal tolerance of the ani animals to the chemicals, while UV deficit and supererythemal doses markedly decreased the tolerance. Pesticide resistance might thus be reduced in farm workers ex exposed to intense UV irradiation in summer. The protective mechanism of UV radiation seems to be associated with a general stimulating effect on metabolic processes, detoxification and elimination of toxic substances, and shifts in trace element, especially copper, metabolism.

75-2753. Adamec, O.; Kosutzky, J.; Fellegicya, M.; Ledec, M.; Bokakova, E. (Nat. Inst. Poultry Husbandry, Ivanka pri Dunaji, Czechoslovakia). **Zmeny v biologickej ucinnosti estrogenov po expozich kurciat niektorym insekticidom z radu chlorovanych uhlovodikov. [Changes in the biological activity of estrogens following exposure of chickens to some chlorinated hydrocarbon insecticides.]** *Vet. Med. (Prague)* 19(6): 337-347; 1974. (31 references) (Czech)

Changes in the biological activity of estrogens in chickens following short-term and long-term administration of chlorinated hydrocarbon insecticides were examined. The activity of a standard dose of estradiol was assessed via the increase in oviduct weight and serum calcium levels between days 22-75 of age. Administration of technical DDT at 100 mg/kg of feed caused slight changes in the biological effects of estrogens. Stimulation of oviduct tissue growth was suppressed, while the insecticides appeared to potentiate the effects of the hormone on the serum calcium level. Administration of lindane at the same dose levels revealed a highly significant depression of the effects of a standard dose of estrogens in both of the indices under investigation. The hazards to poultry resulting from exposure to insecticides are discussed.

75-2754. Strang, R. H.; Rogers, R. L.* (Chemagro Div., Baychem Crop., Vero Beach Lab., Box 2290, Vero Beach, FL 32960). **Translocation of ^{14}C-SAN 6707 in cotton, soybean, and corn.** *Weed Sci.* 23(1): 26-31; 1975. (20 references)

The technique of microautoradiography was used to study the localization of ^{14}C-SAN 6706 [4-chloro-5-(dimethylamino)-2 -(α,α,α- trifluoro-*m*-tolyl)-3 (2*H*)-pyridazinone] in cotton (*Gossypium hirsutum* L. 'Lee') and corn (*Zea mays* L. 'W.F. 9'). SAN 6706 was removed from the treatment solutions by absorption and also by adsorption onto the surfaces of roots. Absorbed SAN 6706 appeared to move primarily in the apoplast and to be translocated acropetally and paterally in the transpiration stream. The herbicide accumulated in striking concentrations in the lysigenous glands and trichomes of the cotton plant. This accumulation is postulated to be a major factor in lowering the effective concentration of SAn 6706 in the leaves of cotton as compared to the leaves of the more susceptible soybean and corn plants, and thus may be a significant factor in the tolerance of cotton to SAN 6706. (Author abstract by permission)

75-2755. Skroch, W. A.; Sheets, T. J.; Monaco, T. J.⅛ (Dep. Hort. Sci., North Carolina State Univ., Raleigh, NC 27606). **Weed populations and herbicide residues in apple orchards after 5 years.** *Weed Sci.* 23(1): 53-57; 1975. (17 references)

Weed population shifts occurred when simazine [2-chloro-4,6 - bis(ethylamino) - *S*-triazine], diuron [3-(3,4-dichlorophenyl) - 1,1-dimethyl - urea], terbacil (3-*tert*-butyl - 5-chloro-6 - methyluracil), and dichlobenil (2,6-

dichlorbenzonitrile) were applied annually for 5 years to an apple orchard. The number of brambles (*Rubus* sp.) and Virginia clematis (*Clematis virginiana* L.) plants increased with terbacil usage. Bramble populations increased with the high rate of dichlobenil and goldenrod (*Solidago* sp.) increased at the low rate. The major vegetation on plots receiving amitrole (3-amino-*s*-triazole) was not altered from that of a mowed check. However, amitrole reduced growth of shallow planted trees. Postemergence applications of paraquat (1,1′-dimethyl-4,4′-bipyridinium ion) four times during each growing season resulted in more bare soil than was in the mowed checks at the end of the fifth growing season. Yields of apples were higher in the simazine, terbacil, and dichlobenil-treated plots than in the mowed checks. Simazine and terbacil residues did not accumulate in the upper 60 cm of soil during the study; a slight accumulation of dichlobenil appeared to occur in the surface 0 to 15-cm. (Author abstract by permission)

75-2756. Phelps, R. P. (Auburn Univ., Auburn, AL). **Toxicity and efficacy of five chemotherapaeutics used in aquaculture when applied to water of different quality.** *Diss. Abstr. Int.* 36(2): 509B; 1975.

Experiments were conducted to determine the effect of water qualilty on the action of copper sulfate, Dylox, formalin, malachite green, and potassium permanganate. The toxicity of these chemicals to channel catfish was determined after 96 hr of exposure in water with different pH, total hardness, ion concentration, and temperature. Effectiveness of these compounds in controlling *Cleidosdiscus* in field waters was examined. The pH influenced the toxicity of all chemicals tested except formalin. Total hardness affected the toxicity of copper sulfate, formalin, and potassium permanganate. The presence of iron influenced the action of copper sulfate, Dylox and malachite green. With increased temperature, the rate of mortality was increased for all chemicals tested, although for some chemicals the cumulative mortality was unchanged. Copper sulfate, Dylox, formalin, and potassium permanganate reduced the number of *Cleidodiscus* from the gills of channel catfish kept in plastic pools; potassium permanganate was the least effective chemical tested. Dissolved oxygen was reduced in treatments receiving copper sulfate, formalin, and potassium permanganate; pH was reduced in the copper sulfate, Dylox and formalin treatments. Temperature was increased slightly only in potassium permanganate experiments. (Author abstract by permission, abridged. Copies of the thesis are available from University Microfilms, Order No. 75-18,034.)

75-2757. Hinderer, R. K. (Univ. Maryland, College Park, MD). **A comparative study of eznyme activities and cytochrome P-450 levels of various tissues of the rat and Japanese quail with respect to their metabolism of several pesticides.** *Diss. Abstr. Int.* 36(2): 565B; 1975.

Enzyme activities and cytochrome P-450 levels were found to vary between tissue fractions and between animals. Liver microsomes had the highest P-450 levels in both rats and Japanese quail. A-esterase was highest in liver microsomes, and B-esterase activities were higher in tissue microsomal fractions. Microsomal amidase activity was highest in rat lung and quail lung and kidney and lowest in liver per mg protein. Glutathione *S*-aryltransferase activity was higher in rat than in quail. Carbaryl metabolism in the rat was greatest in the liver microsomal fractions; 1-naphthol was the major metabolite in all tissue fractions from the rat. In the quail, carbaryl metabolism was greater in the postmitochondrial liver fraction according to the quantities in this tissue fraction. The major carbaryl metabolite in all other quail tissue fractions was 1-naphthol. Very little phosphamidon metabolism occurred in either animal. Chlortoluron metabolism occurred only in the post-mitochondrial fractions of quail liver. The major metabolites were *N*-(3-chloro-4-methyl phenyl)-*N′* - methylurea and *N*-(3-chloro -4- hydroxymethylphenyl) - *N′*-methylurea. One compound was found which did not co-chromatograph with any of the available standards. (Author abstract by permission, abridged. Copies of the thesis are available from University Microfilms, Order No. 75-18,103.)

75-2758. Leffler, C. W. (Univ. Florida, Gainesville, FL). **Ionic and osmotic regulation, metabolic response to salinity, and physiological response to pesticides of juvenile *Callinectes sapidus* Rathbun.** *Diss. Abstr. Int.* 36(2): 609B; 1975.

The osmotic and ionic regulation and the metabolic response to salinity of juvenile *Callinectes sapidus* Rathbun were investigated. Juvenile blue crabs at 25°C hyper-osmoregulate in medium of less than 700 mOs/1 and osmoconform at higher salinities. Hemolymph Na(and Cl- concentrations increase gradually with increasing external concentrations below 700 mOs/1 and increase more rapidly at higher concentrations: only Cl- is hypo-regulated. The internal K(concentration is higher than the external concentration at all external concentrations tested (as high as 15 meq/1). At 16°C and concentrations less than 700 mOs/1 total hemolymph concentrations are higher than at 25°C. The metabolic rates of juvenile blue crabs acclimated to test concentrations between 50 and 1410 mOs/1 are not significantly different. Abrupt transfer from a higher acclimation concentration to a lower concentration results in a large increase in the metabolic rate. At O_2 concentrations greater than 2.0 ml O_2/1 juvenile blue crabs are metabolic regulators. DDT and mirex concentrations in juvenile blue crabs from the Cedar Key, Florida, U.S.A. estuarine zone were low. The effects of ingested DDT and mirex on the physiology of juvenile blue crabs were examined. The crabs are sensitive to these pesticides when the cmpounds are ingested— to mirex more than to DDT. High, subacute internal levels of DDT and mirex result in pronounced metabolic rate elevations, reduction in critical oxygen concentration, inhibition of the autotomy reflex (mirex), and reduced carapace thicknesses. DDT and mirex below acute levels do not affect patterns of osmotic and ionic

regulation. It is concluded that DDT and, to a far greater extent, mirex are potentially disastrous agents with respect to blue crab populations. (Author abstract by permission. Copies of the thesis are available from University Microfilms, Order No. 75-16,404.)

75-2759. Hart, G. J. (Cornell Univ., Ithaca, NY). **The determination of dissociation and phosphorylation constants for the inhibition of cholinesterase by organophosphorus esters in the presence of substrate.** *Diss. Abstr. Int.* 36(2): 688B-689B; 1975.

An account is presented of the development of experimental and theoretical approaches to the study of the inhibition of cholinesterases by organophosphorus esters in the presence of substrate. The fundamental concepts relating to the nature, function and inhibition of cholinesterases are reviewed together with the extensive literature on these topics. The kinetic arguments are developed and transformed to yield the necessary equations for the experimental work that constitutes the remainder of the thesis. The basic methodology, using a recording spectrophotometer, is detailed, followed by presentation of the results obtained using this approach to study a series of novel *O*-ethyl *O*-phenyl *S*-*n*-propyl phosphorothiolates, most of which have leaving groups which show relatively low leaving potential. Stopped-flow studies, using inhibitors which have leaving groups which have relatively high leaving potential, are described. The results using a series of cyclic organophosphorus esters are described; these dioxaphosphorinane derivatives demonstrated special steric and conformational effects of methyl substitutents, on the dissociation and phosphorylation constants for the enzyme-inhibitor reaction. Several cyclic organophosphorus esters which do not phosphorylate the enzyme but act as weak, reversible inhibitors were also investigated; dissociation constants for the interaction of acetylcholinesterase with these compounds are reported. (Author abstract by permission. Copies of the thesis are available from university Microfilms, Order No. 75-17,995).

75-2760. Banasiak, C. F. (Univ. Maine, Orono, ME). **Population structure and reproductive ecology of the red-backed salamander in DDT-treated forests of northern Maine.** *Diss. Abstr. Int.* 36(3): 996B-997B; 1975.

Red-backed salamander (*Plethodon cinereus*, Green) populations in the spruce-fir forest region of northern Maine were studied during the summers of 1971 and 1972 to obtain information on nesting ecology and to determine the effects of low-level DDT residues on reproductive parameters. Study areas received 3 applications of DDT at 1.12 kg per hectare between 1958 and 1964 and residues of 70 to 270 ppb of DDT and its metabolites persisted in salamanders in 1972. Clutches of eggs were found from June 5 to September 7 and first hatch in the field was observed August 21. Average size of 302 clutches was 6.5 which represented a 32 percent reduction from a potential of 9.4 obtained from counts of ovarian follicles. Hatching success among more than 1,100 laboratory-incubated eggs averaged 91 percent and hatchling survival one month post-hatch was 96 percent. No significant differences attributable to DDT spray history were apparent in clutch size, hatching success or hatching survival. An incubation period of 81-84 days at 15.6°C was observed for clutches collected June 6 to 8. Hatch clutches (August 10 to September 5) of laboratory-incubated clutches varied with incubation temperature. Breeding incidence in the field among females ≥ 39 mm S-V length ranged from 35 to 57 percent. Counts of ovarian follicles and eggs per clutch correlated postively with female S-V length. Eighty-nine percent of 217 nests were found in logs, but distribution of nests among logs and stumps conformed to availability. Distribution of all salamanders was correlated with volume of inhabitable logs and stumps and a preference for larger diameter logs and stumps was evident. Minimum populations of 7 to 16 salamanders per 100 m^2 were estimated for five 625 m^2 plots. (Author abstract by permission. Copies of the thesis are available from University Microfilms, Order No. 75-20,265.)

75-2761. Eisele, P. J. (Univ. Michigan, Ann Arbor, MI). **The effects of methoxychlor on aquatic invertebrate populations and communities.** *Diss. Abstr. Int.* 36(3): 1118-1119B; 1975.

The effects of low-level methoxychlor exposure on aquatic invertebrates were investigated in laboratory and field studies using continuous-flow acute and chronic bioassays in the laboratory and continuous dosing of a small stream at 0.2 μg/l methoxychlor for over 1 year. Acute 96-hour bioassays indicated that of the taxa tested, there was a ten-fold difference in toxicity between species. *Gammarus pseudolimnaeus* was the most susceptible to methoxychlor and *Orconectes virilis* the least susceptible (96-hour TL50 0.75 μg/l and 7.05 μg/l, respectively). All stream insects tested, *Cheumatopsyche* sp., *Stenonema* spp., and *Chironomus tentans* had intermediate 96-hour TL50. Good agreement was found between acute bioassays and field dosing, as scuds (*Hyallela azteca*) were also the most susceptible in the stream. Mortality in the chronic 1-month bioassays was greater at 0.2 μg/l than in the stream at the same dosage. Chronic bioassays on the stream insects proved not to be good predictors as there was increased growth and emergence at low dosage levels when compared to controls. Many invertebrate populations experienced reductions due to the stream pesticide dosing. Most species considered "intolerant" in organic enrichment studies (baetids, stoneflies, and scuds) were most affected in terms of significant population reductions. Many "tolerant" taxa (hydropsychids, blackflies, crayfish and dragonflies) were temporarily affected experiencing population reductions in dosed areas for a month after dosing was initiated, but then recovered to control conditions. Other "tolerant" taxa (chironomids and elmids) were not affected by the pesticide dosing. Two species, *Chimarra* sp. and *Hemerodromia* sp., had significant

population increases after dosing was initiated. Methoxychlor was concentrated differentially by crayfish, but there was no resultant mortality. There were no differences in mortality that were attributed to trophic level differences. (Author abstract by permission, abridged. Copies of the thesis are available from University Microfilms, Order No. 75-20,495.)

75-2762. Reif, V. D. (Univ. Michigan, Ann Arbor, MI). **Biotransformations of *o,p'*-DDD.** *Diss. Abstr. Int.* 36(3): 1235B; 1975.

Mitotane *o,p'*-DDD (*o,p'*-TDE) produces atrophy of the adrenal cortex, inhibition of ACTH stimulation of steroidogenesis, and alteration in hepatic metabolism of cortisol. It is used in treatment of Cushing's syndrome and adrenocortical carcinoma. To examine the metabolism of *o,p'*-DDD, several of its potential metabolites were synthesized and characterized. Ether extracts of urine from adrenocortical carcinoma patients treated with *o,p'*-DDD were methylated with diazomethane. The methyl esters for the following compounds were identified: *o,p'*-DDA; the glycine conjugate of *o,p'*-DDA; and 3-methoxy, 4-methoxy-, and 3,4-dimethoxy-substituted *o,p'*-DDA. After oral administration of 100 mg *o,p'*-DDD to three rats, an average of 94.9% was excreted in eight days. In addition to the metabolites found in humans, the serine and aspartic acid conjugates of *o,p'*-DDA, *o,p'*-DDMu, and mono- and dihyxdroxy substituted *o,p'*-DDD were detected. Bovine adrenal homogenates in vitro oxidized *o,p'*-DDD to *o,p'*-DDA, while *p,p'*-DDD was converted to *p,p'*-DDA and 1,1-bis(*p*-chlorophenyl)-2,2-dichloroethanol. The substrate conversion rate was 1-2%. Of the cortex subcellular fractions, the mitochondrial fraction was most active in transforming the substrates with some contribution by the soluble fraction. Transformation by the microsomal fraction was negligible. An NADPH generating system was necessary. (Author abstract by permission, abridged. Copies of the thesis are available from University Microfilms, Order No. 75-20,434.)

75-2763. Percich, J. A. (Michigan State Univ., East Lansing, MI). **Interaction of atrazine with soil microorganisms:population changes, disease enhancement, and herbicide accumulation.** *Diss. Abstr. Int.* 36(3): 1049B; 1975.

A loam soil was amended in the laboratory with technical grade atrazine at 10, 30, and 100 μg or with a commercially formulated product (Aatrex-80 WP) at the equivalent of 30 and 100 μg active ingredient/g. Populations of actinomycetes, bacteria, and fungi were rapidly increased over those in non-treated soil. These increases were in proportion to the amount of atrazine used and persisted for at least 2 months. Among the fungi, populations of *Fusarium* were increased 3- and 7- fold at 30 and 100 μg/g atrazine, respectively. These increases also were sustained for at least 2 months. *Fusarium* populations in the field were increased ca. 2- and 4-fold during a 3-month period, when soil was amended at 30 and 100 μg/g, respectively. Cellulolytic activity was enhanced in soil amended with 30 and 100 μg/g atrazine. Soil amended in the laboratory with technical simazine resulted in rapid increases in numbers of soil microflora, but these increases were not sustained except in the case of actinomycetes. Accumulation of atrazine was studied in actinomycete and fungal hyphae incubated for 48 hours in distilled water, soil, and nutrient broth amended with 5 μg/ml (g) technical atrazine. In water actinomycetes and fungi accumulated atrazine up to 87-fold and 132-fold, respectively. Autoclaved mycelia of these microorganisms accumulated the herbicide to about the level in the ambient medium. In soil, the maximum accumulation by actinomycetes was 26-fold and by fungi 14-fold. Incubation in nutrient media resulted in low levels of accumulation in fungi and approximately 3-fold concentrations in actinomycetes. Atrazine degradation by *Penicillium frequentans* and *Streptomyces* sp. was first evident after 2 hours incubation in nutrient media amended with 225 μg technical atrazine. After 4 days incubation *P. frequentans* had completely degraded the herbicide while in the medium containing *Streptomyces* sp. only 18 μg of the original atrazine remained. The mycelium of both organisms, which first accumulated atrazine, contained no detectable atrazine at the end of the experiment. Accumulation by both organisms to high concentrations, without degradation, occurred in distilled water amended with atrazine. (Author abstract by permission, abridged. Copies of the thesis are available from University Microfilms, Order No. 75-20,880.)

75-2764. Hutacharern, C. (Univ. Missouri, Columbia, MO). **Action and metabolism of chlorpyrifos in termites.** *Diss. Abstr. Int.* 36(3): 1957B-1058B; 1975.

A potential replacement for organochlorine compounds in termite control is the organophosphate chlopyrifos. The toxicity, mode of action, and metabolism of this compound and analogs were investigated in the eastern subterranean termite. Toxicity of organophosphate compounds in termites is closely correlated with in vitro cholinesterase inhibition. Shorter alkyl chain organophosphates are most effective in both respects. Termites treated topically with chlorpyrifos-^{14}C readily absorbed the material and metabolized it to chlorpyrifos oxygen analog, a toxic metabolite and potent cholinesterase inhibitor. There also was evidence for some dechlorination of chlorpyrifos to 3-dechlorochlorpyrifos. Subsequent metabolism of chlorpyrifos and chlorpyrifos oxygen analog to water-soluble metabolites proceeded slowly. The efficacy of chlorpyrifos as a termiticide is obviously related to the rapid formation and relatively slow degradation of toxic metabolites in the eastern subterranean termite. (Author abstract by permission, abridged. Copies of the thesis are available from University Microfilms, Order No. 75-20,123.)

See also 75-2563 75-2564 75-2584 75-2622 75-2859

75-2765. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.** *Academic Press, New York,* 1972, 765 p.

The gas chromatographic analysis of pesticides is discussed with reference to sample preparation, detectors for gas chromatography, qualitative analysis, formulation analysis, and general analytical methods for chlorinated pesticides, organophosphate pesticides, and other, miscellaneous classes of pesticides. In the second portion of the book, specific applications for the formulation and residue analyses of over 100 pesticide compounds are described in detail, with attention given to the preparation of various food and environmental samples for residue determinations. Although most of the pesticides articles in the second portion are abstracted separately, the following were dealt with only briefly by the authors and were not abstracted individually: allethrin, banol, binapacryl, dimetan, dimetilan, ethion, isolan, kelthane (Dicofol), lethane, methyl trithion, morestan, phencapton, phosphamidon, pyrolan, DDT (TDE), actidione, chloranil, cyprex, dexon, dithiocarbamates, glycodin, lastan, mylone, alanap, ametryne, amitrole, carbyne, 2,4-DB, diphenamid, diquat, duraset, falone, gibberellic acid, maleic hydrazide, MCPA, napthaleneacetic acid, paraquat, prometone, propazine, randox, Ro-Neet, sesone, simazine, succinic acid 2,2-dimethylhydrazide, Tillam, 2,4,5-T, trifluralin, dichloropropene-dichloropropane, methyl bromide, and vapam.

75-2766. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Sample preparation.** ***IN:*** *Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 1-38. (60 references)

Sample preparation and handling methods for gas chromatographic analysis are discussed. Variables to be considered in obtaining a valid sample for pesticide residue analysis are considered with reference to the various commodities sampled. The following section on cleanup and extraction deals with: the method of Mills, Onley, and Gaither; the method of Cassil; the method of Langlois, Stemp, and Liska; the sweep codistillation cleanup method of Storherr and Watts; cleanup by partitioning; universal extraction systems for agricultural products, meats, dairy products, soils and dehydrated products, and fats and oils; cleanup by column chromatography on adsorbents other than florisil (i.e., carbon, alumina, silica gel, and mixed adsorbents); cleanup by thin-layer chromatography; acetone precipitation; and gas chromatography without cleanup. The last section deals with derivative formation and includes discussions of conversion to compounds with greater detectability, cleanup by derivative formation, and the formation of derivatives suitable for gas chromatography.

75-2767. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Detectors for gas chromatography of pesticides.** ***IN:*** *Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* Academic Press, New York, 1972, p. 39-76. (130 references)

The gas chromatographic detectors currently available for pesticide residue determinations are discussed. The most popular spectroscopic gas-liquid chromatographic detection systems are the emission detectors; these include microwave detectors, direct current discharge detectors, and flame photometric and sensitized flame emission detectors. The thermionic alkali flame ionization detector is discussed in detail as an inexpensive and sensitive mode of detection; further investigation into the mechanism of alkali-sensitized detection techniques is necessary. The electrochemical detectors measure an electrical change which occurs when a reactive species enters an electrochemical cell; numbered among these detectors are the microcoulometer, electrolytic conductivity detector, and reaction coulometer. The highly sensitive electron capture detector is equipped to monitor the decrease in cell current which occurs when electronegative species absorb slow electrons produced as a result of the ionization of the carrier gas by a radioactive source. In spite of some drawbacks, the exquisite sensitivity of electron capture often obviates other detection techniques.

75-2768. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Qualitative analysis of pesticides.** ***IN:*** *Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 77-106. (104 references)

Since positive identification of pesticides is usually not possible from chromatographic peak retention times alone, confirmation of identity is made by various other chromatographic and nonchromatographic techniques. Identification based on retention time is discussed with reference to retention times, relative retention times, the alteration of retention times by chemical reaction, the removal of interfering compounds, and the use of multiple columns. Specific detectors which respond selectively to compounds containing certain elements or functional groups can be used to detect the presence of specific compounds in complex mixtures without collecting and analyzing fractions of effluent from the chromatographic column. It is especially difficult to identify multiple insecticide residues in a single sample from retention times on a single column; a combination of procedures, however, allows the evaluation and identification of multiple residues in samples having an unknown or incomplete history of treatment. Other methods of qualitative analysis include: the correlation of molecular structure and electron-capturing ability; carbon skeleton chromatography; extraction *p*-values; gas chromatography combined with thin-layer chromatography; and the combination of gas chromatography with infrared spectrophotometry, ultraviolet spec-

troscopy, mass spectrometry, emission spectroscopy, nuclear magnetic resonance spectroscopy, polarography, and photoelectron spectrometry.

75-2769. Pasarela, N. R. (Am. Cyanamid, Agric. Res. Cent., Princeton, NJ). **Formulation analysis.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 107-131. (50 references)

The mechanics, instrumental aspects, and techniques necessary for the development and application of practical quantitative procedures for the assay of pesticide formulations are discussed. Instrumental aspects include detector systems used in quantitative gas chromatographic macromethods, gas chromatographic columns, and the optimization of column temperature and flow rate conditions. Factors influencing the detector response, such as variations in sample size, gas flow rates, and column and detector temperatures, can be compensated for by the use of the internal standard technique; the principle, selection, application procedure, and precision of this technique are discussed. The composition and analysis of formulations is also considered with regard to sample composition, sampling, and sample preparation. Finally, gas-liquid chromatography is compared with the classical methods of pesticide analysis. The former is becoming the method of choice for both pesticide residue and formulation analysis because of its speed, simplicity, specificity, sensitivity, selectivity, accuracy, and precision.

75-2770. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Chlorinated pesticides.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 132-190. (88 references)

Techniques for the separation and analysis of the relatively nonpolar chlorinated pesticides are reviewed. Methods are recommended for the preparation of chlorinated pesticides from fatty materials, nonionic chlorinated pesticide residues in nonfatty foods, chlorophenoxy acids in fatty and nonfatty foods, selected residues in milk, pesticides in tissues and blood, chlorinated insecticides in soils, and pesticides in water. A column cleanup method for animal fat, cleanup on Norit-A carbon, the single-stage cleanup of animal tissue extracts on alumina and silica columns, sweep extraction, the separation of polychlorobiphenyls, cleanup by thin-layer chromatography, and a rapid survey method for blood and serum are also discussed. Detectors which can be used for chlorinated pesticides are the electron capture detector, microcoulometric detector, electrolytic conductivity detector, alkali flame detector, and detectors which use emitted radiation from a sensitized flame. Instruments and general methods useful in the analysis of chlorinated pesticides are discussed with reference to sample concentration, instrumentation, column preparation, column conditioning, sample injection, and quantitative analysis. A final section on chromatographic systems and data includes a tabular presentation of retention data and chromatograms of many chlorinated pesticides, as well as a brief review of programmed temperature gas chromatography, qualitative analysis, and applications of gas chromatography in the analysis of chlorinated pesticide residues.

75-2771. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Organophoshate pesticides.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 191-233. (73 references)

The preparation and analysis of pesticides which contain thionophosphate groups and more polar phosphate groups are reviewed. The first section on sample preparation presents recommended methods for the extraction and cleanup of organophosphorus residues in fatty and nonfatty foods, a sweep codistillation method for organophosphorus residues in fruits and vegetables, a comparison of nine procedures for the removal of phosphorus insecticides and their metabolites from field-treated crops, a procedure for the extraction of organophosphorus pesticides from water, a discussion of the alumina column cleanup of hexane-soluble residues in vegetables, a charcoal column cleanup method for residues in crop extracts, methods for the preparation of oxidation products, a discussion of cleanup by partitioning with aqueous acetonitrile, methods for the determination of total parent insecticide and metabolite residues, a screening method based on the detection of methylate hydrolysis products, miscellaneous cleanup methods, and a method for the determination of metabolites of the hydrolysis products of organophosphorus pesticides in human blood and urine. The use of electron capture, thermionic, spectrometric, and microcoulometric detectors in organophosphorus pesticide analysis is discussed, and the final sections of the chapter deal with chromatographic systems and data, and the identification of organophosphate pesticides.

75-2772. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Miscellaneous pesticides.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 234-267. (81 references)

General methods for the preparation and analysis of sulfur- and nitrogen-containing pesticides, multiclass residues, and various other classes of pesticides are presented. Those pesticides which contain sulfur but not phosphorus are discussed with reference to methods of detection and sample preparation, and chromatographic systems and data. Detection systems for the nitrogen-containing pesticides are reviewed and sample preparation

and analytical methods are discussed individually for the triazines, the substituted ureas and carbamates, and the anilide herbicides. The other classes of pesticides discussed are fumigant mixtures, phenolic pesticides, and organomercurial fungicides. The final section deals with detection systems for residues containing phosphorus, sulfur, and/or chlorine.

75-2773. Shell Development Company. (Biol. Sci. Res. Cent., Analytical Dep., Modesto, CA). **Aldrin and dieldrin.** *IN:Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 268-284.

Procedures for the gas chromatographic analysis of aldrin and dieldrin are detailed. The formulation analysis of these two pesticides is discussed with reference to the principle involved, apparatus and material required, apparatus calibration, sample and standard preparation, procedure, and calculations. The precision of the method for both compounds is estimated to be ±4% of the mean. The recommended method for the residue analysis of aldrin and dieldrin is electron capture gas-liquid chromatography (GLC); the principle behind this method and the reagents and apparatus required are presented. Procedures are also described for: residue extraction from agricultural crops, lean animal tissue, soils, water, and glyceride-containing commodities; the saponification of oil-containing hexane extacts and/or confirmation analysis; and cleanup by solid-liquid chromatography. GLC analysis is discussed with reference to operating conditions, the calibration curve, and sample analysis.

75-2774. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Res. Corp., Syracuse, NY). **Aramite.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 285-286. (2 references)

Two methods have been recommended for the residue analysis of aramite. The first, which involves partial cleanup by shaking with charcoal-attaclay followed by microcoulometric detection, can be used to determine aramite residues down to less than 1 ppm. Analysis is carried out using gas chromatography with a 5% DC-200 silicone oil column at 200°C; with this procedure, aramite can be distinguished from OW-9. The second method can be used to determine aramite in the presence of DDT, toxaphene, and endrin in crop residues. The pesticides are extracted with benzene, separated and cleaned up on a Florisil column, and determined by gas chromatography on a column coated with a DC-710/SE-30 mixed phase. With this method, a linear response is obtained in the range 40-160 ng aramite. The sensitivity of the method is 0.05 ppm, with a mean precision of 4% and a mean accuracy of 96%.

75-2775. Shell Development Company. (Modesto, CA). **Azodrin insecticide and Bidrin insecticide.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 287-298.

A method for formulation analysis of the insecticides azodrin (monocrotophos) and bidrin (dicrotophos) involves extraction of formulated material in acetone or a combination of acetone and trimethyl phosphate; analysis is by gas chromatography in columns packed with 10% DC 200. The apparatus and materials required are discussed as is the procedure and preparation of the sample and standard. The precision of the method for both compounds is estimated to be ±4% of the mean. For residue analysis, samples of agricultural commodities are ground and blended with methanol, diluted with water and washed with hexane, then extracted with chloroform, which is concentrated and transferred to ethyl acetate. The ethyl extract is injected into a gas-liquid chromatographic apparatus equipped with a phosphorus detector. Azodrin can be detected down to levels of 0.01 ppm and Bidrin can be detected down to 0.005 ppm.

75-2776. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Banol.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 299-300. (2 references)

A method for the analysis of banol residues in Bermudagrass, milk, apples, cucumbers, and tomatoes is described. The sample is subjected to liquid chromatographic cleanup and the banol is separated from 6-chloro-3,4-xylenol by extraction from methylene chloride with aqueous sodium hydroxide. The banol is then hydrolyzed in aqueous sodium hydroxide and the solution is shaken with chloroacetic anhydride in benzene, after which a portion of the dried benzene phase is injected into an electron capture gas chromatograph with a column containing 2% XE-60 on Chromosorb W(AW-DMCS) at 165°C. The method is sensitive to 0.04 ppm and banol recoveries from spiked samples of Bermudagrass were 86 and 95% at levels of 3.0 and 0.1 ppm, respectively.

75-2777. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Baytex.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 301-313. (8 references)

Methods are recommended for the residue analysis of Baytex (fenthion) and for the determination of Baytex in Tiguvon feeds. For the determination of Baytex in feeds, the sample is extracted with *n*-hexane and analyzed by gas chromatography. Residue analysis can be carried out using methods employing thermionic emission gas chromatography or flame photometric detection. With the former, the compounds are extracted from the sample, oxidized to the

oxygen analog sulfone, and determined using a thermionic emission flame detector. The method is sensitive to the 0.005 ppm level for residues in eggs and milk and to 0.05 ppm for residues in animal tissues and rice. Experimental procedures for residues in these commodities are detailed. With the second method of residue analysis, extracts of corn, grass, and milk containing Baytex and five of its metabolites are separated by liquid chromatography into three fractions, which are then concentrated and determined by gas chromatography. One of the three fractions from milk requires an additional cleanup by partitioning in a binary solvent system. The recoveries are linear with concentration and sensitivity for each of the six compounds is 0.003 ppm or better.

75-2778. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Chlordane.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 315-318. (13 references)

A method is recommended for determination of the uptake of chlordane vapors by low-moisture content foodstuffs. The chlordane residues are isolated from the samples by acetonitrile-water extraction and Florisil cleanup procedures. Determination is by electron capture gas chromatography using a column of 3% SE-30 at 190°C. Experimental procedures for the isolation of chlordane from flour, rice, and sugar and for the subsequent gas chromatographic analysis and calculations are detailed.

75-2779. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Chlorobenzilate.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 319-321. (3 references)

Methods for the formulation analysis and residue analysis of chlorobenzilate are described. Chlorobenzilate formulations are analyzed using a 1 m X 3.5 mm glass column containing 5% OV-25 or Chromosorb W AW DMCS at 210°C. The carrier gas is helium and flame ionization is recommended. A suitable internal standard is succinic acid dibenzyl ester. The recommended method for residue analysis involves benzene extraction followed by Nuchar cleanup for grapes and Florisil column cleanup for cottonseed. Determination is by microcoulometric gas chromatography. Recoveries of chlorobenzilate from grape and cottonseed controls fortified at 1.0 ppm ranged from 77-96%, while those from cottonseed fortified at 0.1 ppm were 60%. The sensitivity of the method is 0.05 ppm chlorobenzilate. An alternate method involves extraction from crop material by blending with acetone-hexane, cleanup on a column containing aluminum oxide, and gas chromatography using a 2 ft X 1/4 in. glass column packed with 3% Carbowax 20M on 60-80 mesh Gas Chrom Q and microcoulometric detection. Oily samples require separation of the oil by extraction prior to column chromatography.

75-2780. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Chlorthion.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig, and J. Sherma, Eds., Academic Press, New York, 1972, p. 322-324. (2 references)

Methods for the analysis of chlorthion residues on plant materials and in cocoa are described. Plant materials are extracted with methyl ethyl ketone-hexane. The extracts are cleaned up on magnesia and determined by electron capture gas chromatography using a column of 10-20% silicone elastomer E-301 with 2.5% w/w Epikote 101 at 160 or 188°C. Cocoa beans are extracted with benzene and cleaned up by partition with nitromethane and then hexane prior to chromatography on 2.5% E-301 plus 0.25% Epikote 1001. Using this procedure, chlorthion added to lettuce at a concentration of 0.08 ppm was recovered to the extent of 84%. The limit of detection of chlorthion in cocoa is 0.2 ng.

75-2781. Shell Development Company. (Modesto, CA). Ciodrin insecticide. *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 325-331.

Procedures for the formulation analysis and residue analysis of Ciodrin (crotoxyphos) are described. Ciodrin emulsifiable concentrate formulations are diluted with chloroform and dust formulations are extracted with chloroform prior to gas chromatographic analysis on a 4 ft X 1/4 in. stainless steel column packed with 10% DC-200 on 80-100 mesh Gas Chrom Q at a column temperature of 245°C. The precision of the method is estimated to be ±4% of the mean. For the determination of Ciodrin residues in animal tissues and milk, the tissue samples are extracted with acetone and the milk and milk fat samples are extracted with acetone and sodium sulfate. The extracts are cleaned up on polyethylene-coated alumina chromatographic columns by eluting with a 1:1 acetone-water solution. The pesticide is partitioned into ethyl ether, which is concentrated and transferred to ethyl acetate. The cleaned up extracts are analyzed by gas-liquid chromatography employing either a flame photometric or alkali flame detection system. Ciodrin concentrations as low as 0.03 ppm can be determined using this procedure.

75-2782. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Co-Ral (coumaphos).** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 332-339. (4 references)

Methods for the residue analysis of coumaphos and

for its determination in feeds are described. For the analysis of feed mixtures containing 30-125 ppm coumaphos, the pesticide is extracted from the feed with hexane in a Soxhlet extractor and separated from the feed extract by gas chromatography. Analysis is on a Microtek 2500 or PE-881 electron capture gas chromatograph equipped with a 2 ft X 0.25 in. stainless steel column packed with 3% XE-60 on 80-100 mesh Gas Chrom P; the detector temperature is 215°C. For the determination of coumaphos residues in eggs, the sample is blended with acetone, reblended with chloroform, then shaken with acetonitrile. Cleanup is by Florisil column chromatography, with further cleanup by acetone and chloroform extraction. Analysis is by gas chromatography on a 15 in X 3 mm i.d. borosilicate glass column packed with 5% D.C.-200 coated on 8-100 mesh Gas Chrom Q. The level of sensitivity of the method is 0.001 ppm, with a recovery range of about 80-115% for both coumaphos and its oxygen analog. Coumaphos residues in milk and feces involves extraction, separation by liquid chromatography on silica gel, cleanup by hexane-acetonitrile partitioning, and gas chromatography on a column containing 10% DC-200 on Gas Chrom Q at 210°C. Coumaphos and its oxygen analog are detected with a phosphorus flame photometric detector with a sensitivity of better than 0.003 ppm for milk and 0.005 ppm for feces.

75-2783. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **DDT.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 340-344. (26 references)

DDT residues may be separated on the usual silicon stationary phases, except for the following analog pairs: *p,p'*-DDD and *o,p'*-DDE; *p,p'*-DDE and *o,p'*-DDD; and *p,p'*-DDD and *o,p'*-DDT. The latter two pairs may be separated by chromatography on a column of 2.5% SF-96 and polyester 2,2-diethyl-1,3-propanediolisophthalate on Celite after alkali treatment. PCBs, which will interfere in standard methods for determining chlorinated pesticides, are separated from DDT and its analogs by column chromatography on silicic acid—Celite 545. Extraction and cleanup procedures for the recovery of DDT from milk, butter, vegetable oils, animal feeds, broccoli, corn, vegetables, fats and oils, soil, green alfalfa, and blood serum are briefly described. For the analysis of *p,p'*-DDA in urine, the sample is mixed with 2% acetic acid in hexane, dried, treated with boron trifluoride-methanol reagent, heated, extracted with hexane, and analyzed for the methyl ester by electrolytic conductivity or microcoulometric gas chromatography. Gas chromatographic procedures applicable for the analysis of other chlorinated pesticides can also be used for the determination of DDT residues in various samples.

75-2784. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Diazinon.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 345-349. (5 references)

Methods for the formulation analysis and residue analysis of diazinon are discussed. Water-dispersible powder concentrates are extracted with acetone. Fluorene and acetone are added to the extract, which is analyzed using a 100 X 0.4 cm stainless steel column containing 10% w/w high vacuum silicone grease on Celite 545 at 170°C. The mean recovery is 100.1%. For the determination of diazinon and its oxygen analog in animal tissues, the sample is triturated with sand and sodium sulfate, eluted with methanol or ether, and concentrated. Use of a thermionic phosphorus detector makes cleanup unnecessary, analysis being carried out on a 5 ft X 1/8 in. o.d. glass column packed with 1.5-2.0% XE-60 on 100-200 mesh Chromosorb W. Recoveries range from 90-100% for 0.5-1.0 ppm diazinon and from 81-94% for 0.2-2.0 ppm diazoxon. For the determination of diazinon on field treated corn, the residue is extracted with ethyl acetate and the extract is treated with charcoal prior to analysis on a gas chromatograph equipped with a flame photometric detector. The 61 cm X 4 mm i.d. aluminum chromatographic column is packed with 2% w/w diethylene glycol succinate on 100-120 mesh Gas Chrom Q. Recoveries are 95-98% for samples containing 0.04-1.0 ppm diazinon and 94-100% for samples containing 0.1-1.0 ppm diazoxon. The procedure is sensitive to 0.01 ppm diazinon and 0.05 ppm diazoxon.

75-2785. Leary, J. B. (Ortho Div., Chevron Chem. Co., Richmond, CA). **Dibrom (naled).** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 350-355. (1 reference)

Methods for the formulation and residue analysis of naled are described. Formulated samples are extracted or diluted with acetone and analyzed by gas chromatography using a thermal conductivity detector. The chromatographic column is 2 ft X 1/4 in. o.d. glass packed with 10% SE-52 on Chromosorb G, AW/DMCS, 70-80 mesh. A temperature-programmed gas chromatographic method utilizing a thermionic detector has been developed for the simultaneous determination of naled and its primary metabolic product, DDVP (dichlorvos). The naled and DDVP residues are extracted with hexane and partitioned into water by evaporation of the hexane. Interfering substances are removed by filtering the water. The water is then extracted with hexane, and naled and DDVP are determined using a 50 cm X 1/8 in. o.d. Teflon tube column packed with SE-54, 15% w/w on Gas Chrom Q, 100-200 mesh. Average recovery values ranged between 70 and 80% and the sensitivity of the method ranges from 0.005-0.01 ppm for DDVP and from 0.01-0.02 ppm for naled. The procedure has been used with grapes, alfalfa, beans, peas, hay, celery, and sugarcane.

75-2786. Boyd, J. E. (Am. Cyanamid, Agric. Res. Cent., Princeton, NY). **Dimethoate.** *IN: Analytical methods for pesticides and plant growth regulators, Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 357-375. (14 references)

Methods are recommended for the formulation and residue analysis of dimethoate. Liquid formulations or acetonitrile extracts of solid formulations are diluted to the appropriate volume with acetonitrile and the insecticide content is determined by a gas-liquid chromatographic procedure employing an internal standard technique. The chromatographic column is a 60 cm borosilicate glass tube (4 mm i.d., 6 mm o.d.) packed with 5% DC-550 on Anadrom ABS, 70-80 mesh. Detection is by flame ionization. Peak height or peak area may be used to measure the gas chromatographic response. Residues of dimethoate and its oxygen analog dimethoxon are extracted from the prepared sample with methylene chloride or acetonitrile, purified by a combination of cleanup steps appropriate to the particular type of sample being analyzed, and measured by gas-liquid chromatography with an instrument equipped with a selective phosphorus-sensitive detector. The recommended column is a 60 cm borosilicate glass tube (4 mm i.d., 5 mm o.d.) packed with 11% DC-200 on Gas Chrom Q, pretreated with Versamid 900 polyamide resin, 60-80 mesh. A flame photometric detector or alkali flame ionization detector may be used. The procedure is sensitive down to 0.05 ppm in commodities of plant origin, to 0.02 ppm in animal tissues, and to 0.002 ppm in milk.

75-2787. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Dimetilan.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 376. (1 reference)

Procedures for the analysis of dimetilan in beer, olives, olive oil, and olive press-cake are described. Beer is extracted with chloroform; olives and olive press-cake are extracted with methanol followed by dilution with water and reextraction with chloroform; and olive oil is extracted with water followed by chloroform. Cleanup involves acetonitrile extraction (necessary only for olives and olive press-cakes) followed by elution on an alumina (activity V) column using hexane-ethyl ether, then ethyl ether alone. Gas chromatographic determination is on a 1 m X 5 mm glass column packed with 2% NPGS on chromosorb G, 80-100 mesh, 235°C, with helium carrier gas flowing at 70 ml/min. The sensitivity of the method is 0.001 ppm in beer and 0.0225 ppm in olive oil products using the Coulson conductivity detector.

75-2788. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Di-syston (disfulfoton; thio-demeton).** *IN: Analytical Methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 377-386. (9 references)

Methods are recommended for the determination of disulfoton residues in various crops and products and in tobacco plants. Disulfoton is extracted from corn and soybeans with chloroform, then acetonitrile, and is extracted from cottonseed with benzene-ethanol, then acetonitrile. It is extracted from potatoes, raw sugar cane, sorghum fodder, strawberries, processed sugar, molasses, wheat, wheat straw, and sorghum seed with chloroform. Precipitation of the plant substances in acetone followed by extraction with chloroform removes pigments, and oxidation converts disulfoton and its metabolites to the corresponding sulfones. Analysis is on a 3.5 ft X 1/8 in. borosilicate glass chromatographic column packed with 10% DC-200 and 1.5% QF-1 on 80-100 mesh Gas Chrom Q. Detection is by potassium choride thermionic flame ionization. Recoveries range from 75-100% and none of a variety of organophosphorus pesticides tested interfered with the procedure. The sensitivity of the method is about 0.02 ppm. Tobacco plants are extracted with chloroform-methanol and the extracts are separated into three fractions by liquid chromatography. A portion of each fraction is analyzed by gas chromatography with a flame photometric phosphorus detector. The column is 45 cm X 4 mm i.d. glass packed with 10% DC-200 w/w on 80-100 mesh Gas Chrom Q. Recoveries range from 88-100%, the sensitivity is 0.01-0.04 ppm, and the response is linear up to the 250 ng level.

75-2789. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Dylox.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 387-392. (8 references)

Procedures for the formulation and residue analysis of dylox (trichlorfon) are described. Dylox powder formulation is extracted with ethyl acetate and analyzed by gas chromatography on a 5 X 4 mm i.d. pyrex glass column packed with 25% Carbowax 20M on 80-90 mesh Anakron ABS. The method is sensitive to 0.01 μg and a precision of 1-2% has been obtained for several commercial formulations. Dylox residues are extracted from alfalfa with sulfuric acid, subjected to water-ether partition, and determined by thermionic flame ionization gas chromatography. The 6 ft X 1/4 in. borosilicate glass column is packed with 16% XF-1150 on 60-80 mesh acid-washed Chromosorb W. The sensitivity of the method is about 0.02 ppm and recoveries range from 74-86% for 0.1 ppm Dylox and from 102-105% for 12.5 ppm Dylox. None of 49 registered phosphorus pesticides interfered with the procedure. For the analysis of Dylox in soils, the residue is extracted with chloroform, concentrated, and injected into the chromatograph without cleanup. Cottonseed samples are blended with chloroform and the Dylox is extracted from Skellysolve B with water. The pesticide is then partitioned into chloroform, the solvent evaporated, and a portion injected into the gas chromatograph.

75-2790. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Endrin.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 393-395. (20 references)

Endrin can be recovered from products such as alfalfa, wheat, cabbage, dairy products, animal feeds, vegetables, soils, water, milk, tissue, fatty vegetables, urine, and apples using standard procedures for the extraction and cleanup of chlorinated residues. Analysis is by gas chromatography on columns containing 5% DC-200 and 4% SE-30 plus 6% QF-1 on Gas Chrom Q at 190°C, or the latter mixed phase on Anakrom ABS at 200°C. Under some chromatographic conditions, the moderately stable insecticide is sensitive to high temperature. No decomposition is noted at temperatures up to 225°C when surface-textured soda lime glass beads are used. Storage and extraction of moist soils prevent major losses through isomerization.

75-2791. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Guthion.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 397-403. (6 references)

Methods for the analysis of methyl and ethyl guthion (azinphosmethyl) technical and formulated samples and residues are described. The technical and formulated samples are rinsed with carbon disulfide and injected with a standard into a gas chromatograph equipped with a 20 X 1/8 in. glass column packed with 10% DC-11 on 60-80 mesh Gas Chrom Q and a flame ionization detector. Guthion residues in milk can be detected at a level of 0.038 ppm using a 5 ft X 0.125 in. column of 5% SE-30 on Chromosorb W at 265°C. For the residue analysis of snap beans, guthion is extracted with chloroform and the extract is cleaned up using a Skellysolve B-acetonitrile partition and Florisil column procedure. Determination is by thermionic emission gas chromatography using a 15 in. X 3 mm i.d. borosilicate glass column packed with 5% DC-200 silicone oil coated on 70-80 mesh DMCS-treated Chromosorb G. The average recovery is 97% with a sensitivity of 0.5 ppm. The response of the thermionic detector to Guthion is linear up to about 100 ng.

75-2792. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Heptachlor.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 404-407. (16 references)

Procedures are described for the formulation and residue analysis of heptachlor. Liquid formulations are extracted with carbon disulfide and solid formulations are extracted with pentane in a Soxhlet apparatus. Analysis is by flame ionization gas chromatography, the 5 ft X 1/8 in. o.d. Pyrex glass column being packed with Versilube F-50 dissolved in methylene chloride on 100-120 mesh Gas-Chrom Q. Reference grade aldrin is used as an internal standard. Gas chromatography has also been used to determine heptachlor residues in soils, various crops, milk, tissue, and total diet. Since heptachlor forms an epoxide in biological media, both compounds must be determined for residue analysis. Heptachlor can be separated from the interfering contaminant γ-chlordane on a Florisil column.

75-2793. Barney, J. E.; Ja, W. Y.; Shelman, D. L. (Stauffer Chem. Co., Western Res. Cent., Richmond, CA). **Imidan.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 408-413. (3 references)

Methods are recommended for the formulation and residue analysis of Imidan (phosmet). Imidan formulations are extracted with carbon disulfide-chloroform-acetone and analyzed by gas chromatography with carbophenothion as internal standard. The 1.5 ft X 0.25 in. o.d. Pyrex glass column is packed with 12% SE-30 on 80-100 mesh Gas Chrom Q. Precision with a relative standard deviation of less than ±1% is obtainable, best results being achieved using on-column injection without an elevated inlet or flash heater temperature. For Imidan residue analysis, most crops are extracted with benzene and cleaned up by a one-step charcoal shakeout followed by filtration through a 0.45 μ Millipore filter. Cottonseed and cotton foliage require acetonitrile partition prior to the shakeout procedure. Imidan is then determined by gas chromatography with an alkali flame ionization detector. The 1 ft X 0.125 in. o.d. Pyrex column is packed with 10% DC-200 on 100-120 mesh Gas Chrom Q. This method will detect 0.05 ppm Imidan at twice the noise level of 1% full scale and commonly used pesticides interfere. Imidan (0.1-1.0 ppm) has been recovered from alfalfa at levels of 90-100%. The method has been successfully used with alfalfa, apples, cherries, cotton foliage, cottonseed, dried peaches, dried prunes, grapes, green beans, nectarines, peaches, pears, plums and prunes.

75-2794. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Kelthane (dicofol).** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 415-416. (9 references)

Kelthane (dicofol) appears to decompose almost quantitatively during gas chromatography and it may show up to seven peaks when analyzed by this technique under some conditions. However, if a column of silicone on firebrick is preconditioned to Kelthane, 90-95% of the compound will remain undecomposed, the rest being decomposed to dichlorobenzophenone. Analysis on a column of Chromosorb W coated with 5% DC-11 will also

yield only undecomposed Kelthane and its breakdown product. In addition, a procedure has been devised for separating Kelthane and its dichlorobenzophenone degradation product on the standard Florisil column so that the amount of dichlorobenzophenone originally present in the residue can be distinguished from that formed during chromatography. Kelthane is eluted with 10% diethyl ether in petroleum ether. The eluates are concentrated and analyzed by gas chromatography. Gas chromatography has been used to determine Kelthane residues in total diet samples, almond hulls, orange rinds, and soil.

75-2795. Boyd, J. E. (Am. Cyanamid Co., Agric. Res. Cent., Princeton, NJ). **Malathion.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 418-431. (23 references)

Methods for the formulation and residue analysis of malathion are described. Liquid formulations or acetonitrile extracts of solid formulations are diluted to the appropriate volume with acetonitrile, and the insecticide content is determined by a flame ionization gas-liquid chromatographic procedure employing an internal standard technique. The 60 cm borosilicate glass chromatographic column (4 mm i.d., 6 mm o.d.) is packed with 5% OV-22 on Gas Chrom Q, 60-80 mesh. Either peak height or peak area may be used to measure the gas chromatographic response. Residues of malathion are extracted with chloroform, purified by the appropriate cleanup procedures, and analyzed by gas-liquid chromatography with selective phosphorus-sensitive detection. The borosilicate glass column is packed with 1% Reoplex 400 on 60-80 mesh Gas Chrom Q. This method has yielded recoveries in excess of 80% at levels down to 0.05 ppm in alfalfa, bean foliage, cottonseed, tobacco, wheat foliage, and wheat grain, and presumably would be applicable to a variety of other samples. If sufficient resolution cannot be achieved to yield adequate recoveries with acceptable blank values, the extracts should be analyzed on a gas chromatographic column of 11% DC-200 on Gas Chrom Q, pretreated with Versamid 900 polyamide resin.

75-2796. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Meta-systox.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1082, p. 432-440. (4 references)

Procedures are recommended for the analysis of Meta-systox (methyl demeton) residues in moist crops, cottonseed and walnut, and poultry tissues and eggs. For determination in moist crops such as lettuce and sugar beets, Meta-systox-R and its sulfone metabolite are extracted with acetone, then chloroform, oxidized, and analyzed by gas chromatography using a phosphorus-sensitive thermionic emission detector. The 3.5 ft X 1/8 in. o.d. borosilicate glass column is packed with 10% DC-200 and 1.5% QF-1 solution coated on 80-100 mesh Gas Chrom Q. The sensitivity of the method is 0.05 ppm for these crops. Essentially the same procedure is used for the determination of Meta-systox residues in cottonseed and walnuts; however, the samples are extracted with chloroform then water. The sensitivity of the method for these crops is 0.01 ppm. Again, essentially the same procedure is used for the determination of residues in poultry tissues and eggs. In this case, however, there is an additional Skellysolve-water partition step and the 1 ft X 4 mm i.d. borosilicate glass column is packed with 5% OV-17 solution coated on 80-100 mesh Gas Chrom Q. The method is sensitive to 0:01 ppm and the response is linear up to 0.8 ppm. Recoveries range from 75-100% for eggs containing 0.01 ppm and for poultry tissues containing 0.1 ppm.

75-2797. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Methoxychlor.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 441-442. (5 references)

Methoxychlor residues in animal feeds can be determined with 70-100% recoveries utilizing electron capture gas chromatography at 205°C with a stationary phase of 5% SE-30. Three peaks with aldrin ratios of 2.89, 3.62, and 4.23 have been obtained; *p,p'*-DDT may interfere with the first peak and a minor endrin peak may interfere with the 3.62 peak. Since the third methoxychlor peak is not interfered with by other common chlorinated pesticides, it is used to measure methoxychlor quantitatively and to calculate methoxychlor interference with DDT and endrin. Methoxychlor was detected in four different crops at concentrations of 0.1-10 μg/ml using benzene extraction and cleanup with acid-washed Norit A and microcoulometric gas chromatography; recoveries ranged from 86 to 97%. Similarly, 95-101% of the methoxychlor added to corn oil, cottonseed oil, rapeseed oil, and beef fat was determined by acetone extraction and chromatography using 4% SE-30 plus 6% OF-1 at 175°C. Colorimetry has also been successfully applied to the determination of methoxychlor residues.

75-2798. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Parathion.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 445-446. (6 references)

Parathion and paraoxon have been successfully chromatographed on a 125 X 0.4 cm column packed with 0.25% Epikote resin 1001 and 2.5% silicone elastomer E-301 on 100-120 mesh Celite, and parathion, methyl parathion, and paraoxon were satisfactorily resolved on a column of 6% QF-1 coated on DMCS Chromosoro G. Although paraoxon can be resolved on a column contain-

ing 5% SE-30, ethyl parathion, if present, will have the same retention time. Parathion and methyl parathion were determined in the presence of chlorinated pesticides using solvent extraction, cleanup by thin-layer chromatography on silica gel, and identification by gas chromatography on a 1.2 m X 0.6 cm o.d. aluminum column packed with equal portions of acid-washed Chromosorb P supporting 5% DC-200 and unwashed Chromosorb W supporting 5% DC-11 at 180°C. Parathion can be detected using a microwave emission detector, and electron capture detection is suitable for both parathion and methyl parathion, but not as satisfactory for paraoxon. Methods are detailed for the detection of parathion in celery, orange essence, cabbage, Southern peas, and plasma.

75-2799. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Perthane.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 447-448. (1 reference)

Perthane residues are determined in the presence of DDT and DDD (TDE) by treating the mixture with alkali to form olefins, which are then separated and determined by electron capture gas chromatography. For residues in leafy vegetables, the chopped, blended, and processed sample is eluted through activated Florisil with 6% ethyl ether in petroleum ether. The eluate is evaporated, refluxed with 2% sodium hydroxide, extracted, and treated with alkali to form olefins as above. The 3 ft U-shaped gas chromatographic column is coated with a 1:1 mixture of SF-96 and 2,2-diethyl-1,3-propanediol-isophthalate polyester. In samples of kale, collards, broccoli, and spinach spiked with 1-20 ppm perthane and 1-10 ppm DDT and DDD, perthane recoveries averaged 89% and DDT and DDD recoveries averaged 94-95%. The olefin of perthane is much more sensitive to electron capture detection than is the parent compound.

75-2800. Shell Development Company. (Modesto, CA). **Phosdrin insecticide.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 450-456.

Methods are recommended for the formulation and residue analysis of Phosdrin (mevinphos). Liquid formulations of Phosdrin are diluted with chloroform to provide a solution that can be readily analyzed by gas chromatography. The 4 ft X 1/4 in. stainless steel chromatographic column is packed with 5% DC-200 on 80-100 mesh Gas Chrom Q. Quantitation is achieved by a comparison of peak height or area obtained for the sample solution with a similar measurement for a standard solution of Phosdrin. The precision of the method is estimated to be ±4% of the mean. For the detection of residues of the α-isomer of Phosdrin, the crop sample is macerated and extracted with ethyl acetate. The extract is exchanged to hexane and cleaned up on a mini-column packed with 3:1 Florisil-Celite mixture. The eluate is then concentrated and analyzed by gas-liquid chromatography using a flame photometric or alkali flame detector. The β-isomer is extracted and cleaned up along with the α-isomer and concentrations greater than 0.10 ppm can be detected if the α-isomer response does not completely mask the small β-isomer peak. Concentrations as low as 0.02 ppm of the α-isomer can be readily detected.

75-2801. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Piperonyl butoxide.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 458-460. (2 references)

For the formulation analysis of piperonyl butoxide, the sample of technical insecticide is dissolved in a solution of technical grade dioctyl phthalate (internal standard) in *n*-heptane. The solution is then chromatographed on a Barber-Colman Series 5000 gas chromatograph equipped with a flame ionization detector and a 2 ft X 8 mm o.d. glass column packed with 10% Apiezon L on Anakrom ABS, 110-120 mesh. Piperonyl butoxide is determined by relating the area of its peak to that of the dioctyl phthalate peak, which are not in the same area even at high sensitivity. The standard deviation of this method is about 2.0% and a plot of sample weight vs. the area ratio is a straight line with sample sizes between 0.3 and 1.0 gm. The method is applicable to samples containing 25-75% piperonyl butoxide and, since pyrethrins do not interfere significantly in a normal piperonyl butoxide to pyrethrin ratio, the procedure can also be used with common blends of pyrethrins and piperonyl butoxide.

75-2802. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Pyrethrins.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 461-470. (13 references)

Methods are recommended for the formulation and residue analysis of pyrethrins. The active ingredients in commercial mixtures of pyrethrins, piperonyl butoxide (PBO), and *n*-octylbicycloheptene dicarboximide (NOBD) are measured simultaneously by gas chromatography after cleanup on Florisil to remove oil-based materials and other substances that would otherwise interfere with the analysis of the NOBD component of the formulation. A Varian Aerograph Series 1200 chromatograph equipped with a flame ionization detector was used with two 5 ft X 1/8 in. spiral borosilicate glass columns containing 3% and 5% SE-30 silicone, respectively, coated on Chromosorb W. With this method, individual pesticide components present in amounts ranging from 0.05-50% can be measured accurately. Pyrethrin residues are extracted from meat and tissue samples with petroleum ether and from

milk with ether-petroleum ether, after which the extracts are partitioned between acetonitrile and petroleum ether to remove much of the extracted fat. Chromatography through Florisil separates the pyrethrins from chlorinated pesticides and final cleanup is by thin-layer chromatography with determination by electron capture gas chromatography on a 1/8 X 5 in. column packed with 1% QF-1 plus 1% Epon 1001 on Aeropak-30, 70-80 mesh. Recoveries in milk ranged from 50% at the 0.02 ppm level to 88% at the 0.1 ppm level; sensitivity is 0.05 ppm on a whole-milk basis.

75-2803. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Ronnel (fenchlorphos).** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 473-477. (5 references)

For the determination of ronnel (fenchlorphos) residues in feeds, the sample is extracted with acetone, the extract is passed through a Florisil column to remove contaminants, and the ronnel is determined by electron capture gas chromatography. The 4-6 ft X 3-4 mm i.d. column is packed with 5% SF-96 on 60-80 mesh Chromosorb W. Recoveries from samples containing 0.04% ronnel were 95-100%, low results being obtained after storage of the samples for several months. Ronnel residues are extracted from milk by *n*-hexane elution on a Florisil column; from omental, renal, and s.c. fat by extraction with *n*-hexane and acetonitrile followed by hexane elution from a Florisil column, and from muscle, liver, kidney, heart, brain, and spleen tissues by acetone and hexane followed by Florisil column cleanup. The extracts are determined by gas chromatography on a 4 ft X 1/4 in. o.d. glass column packed with 5% SF-96 coated on 80-100 mesh Chromosorb W. The recoveries from milk were 87% at the 0.01 ppm level, those from fat were 77% at the 0.005 ppm level, and those from other tissues were 85-94% at the 0.005 ppm level. Ronnel can be detected at 0.001 ppm in milk and at 0.0005 ppm in body tissues.

75-2804. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Sevin (carbaryl).** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 478-482. (15 references)

For the residue determination of sevin (carbaryl) in cows' milk, the milk sample is extracted with pentane-ether and cleaned up by acetonitrile partitioning. The residues are subsequently hydrolyzed to 1-naphthol, part of which is trichloroacetylated and part of which is brominated and acetylated. Both derivatives are determined by electron capture gas chromatography on the same column at 190°C. The 183 X 0.4 cm i.d. glass column is packed with 7% DC-200 on 80-100 mesh Gas Chrom Q. Extracts of bees, bee bread, and bee pollen require chromatographic cleanup prior to derivatization. The retention time for the trichloroacetylated derivative is 6.4 min and that for the brominated derivative is 7.7 min. Standard curves for both derivatives are linear from 0-0.7 ng sevin. Recoveries from milk fortified at levels of 0.005-0.10 ppm ranged from 70-110% for the trichloroacetate derivative and from 79-112% for the brominated derivative with generally good agreement between the two. Other methods for the residue analysis of sevin are briefly reviewed.

75-2805. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Systox.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 483-487. (2 references)

For the determination of systox (demeton) in technical formulations, the thiono isomer is converted to the thiol isomer on the gas chromatographic column and the total systox is determined by comparing the peak heights of the sample and a standard; sulfotepp is determined simultaneously. The chromatograph should be equipped with a thermal conductivity detector and a 6 ft X 1/4 in. stainless steel column packed with 20% XE-60 on 70-80 mesh Gas Chrom W or 60-80 mesh Gas Chrom P. For the determination of systox residues in soil, the sample is extracted with acteone and water followed by chloroform. The evaporated extract is then oxidized to convert the systox isomers and metabolites to their corresponding sulfones, and the residue is determined by thermionic emission gas chromatography. Recoveries from clay, muck sand, and silt loam ranged from 74 to 110% at the 0.5 ppm level. The sensitivity of the method is about 0.02 ppm and the response is linear up to 2.5 ppm.

75-2806. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Tedion (tetradifon).** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 488-492. (5 references)

Residues of Tedion (tetradifon) and Thiodan (endosulfan) are extracted from vegetables with alcohol-hexane and are cleaned up by ethyl ether-petroleum ether elution on a Florisil column. Additional cleanup on carbon is required when waxy vegetables are analyzed. Fractional elution from the Florisil column separates Thiodan from DDT, which has a conflicting retention time on gas chromatography. Analysis is on an instrument equipped with a silver electrode halogen microcoulometric titration cell, a 1 mV recorder, a disk integrator, and a 6 ft X 1/4 in. o.d. aluminum column packed with 15-20% w/w Dow Corning high vacuum silicone grease or DC-200 fluid on 30-60 mesh acid-washed Chromosorb P. The column temperature is 230°C, the injection block temperature is 250°C, the nitrogen carrier gas flow rate is 120 ml/min, and the sensitivity range is 128. Recoveries of Thiodan (1-2

ppm) and Tedion (2 ppm) from broccoli were 78-95% (mean 87%) and 95-102% (mean 97%) respectively.

75-2807. Boyd, J. E. (Am. Cyanamid Co., Agric. Res. Cent., Princeton, NJ). **Thimet (phorate).** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 493-510. (19 references)

Liquid formulations of Thimet (phorate) or acetonitrile extracts of solid samples are diluted to the appropriate volume with acetonitrile and the insecticide content is determined by a gas-liquid chromatographic procedure employing an internal standardization technique. The gas chromatograph should be equipped with an on-column injection system and a flame ionization detector. The 60 cm borosilicate glass column (4 mm i.d., 6 mm o.d.) is packed with 5% DC-550 on Anakrom ABS, 70-80 mesh. Residues of phorate and its metabolite are extracted from the prepared sample with chloroform, depending on the type of sample. Cleanup involves hexane-acetronitrile partitioning, oxidation with metachloroperbenzoic acid to convert the phorate-related residues to phoratoxon sulfone, precipitation of interfering extractives, and/or Florisil column chromatography. Analysis is by gas-liquid chromatograph using a selective phosphorus-sensitive detector. The 120 cm borosilicate glass column (4 mm i.d., 6 mm o.d.) is packed with 5% DC-200 on Gas Chrom Q, 60-80 mesh. This procedure is applicable for the analysis of oily seeds, nuts, grains, plant foliage, hay, liver, kidney, muscle, fatty tissues, and eggs.

75-2808. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Thiodan (endosulfan).** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 511-513. (11 references)

Standard formulations of the two Thiodan (endosulfan) isomers are analyzed by gas chromatography using a thermal conductivity detector. The 6 ft X 1/4 in. spiral stainless steel column is packed with 30% DC-11 on 35-80 mesh Chromosorb. Miscible formulations of Thiodan are diluted with *n*-hexane prior to chromatography. The *n*-hexane solvent has a retention time of 1 min, and those of Thiodan A and B are 10.5 and 14.0 min, respectively. Gas chromatography has also been used to determine Thiodan residues in grass, soil, and bean plants; to identify Thiodan metabolic products in the organs, urine, and feces of the mouse; and to study Thiodan penetration and metabolism in houseflies and other insects. The α-and β-isomers have been confirmed in residues by reduction to the same diol with lithium aluminum hydride in tetrahydrofuran and subsequent silylation to the disilyl ether; chromatographic analysis was on a mixed phase column (4% DC-11 and 6% QF-1, 1:1) at 200°C.

75-2809. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Toxaphene.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 514-518. (9 references)

For the determination of toxaphene residues, the sample extract should be evaporated without heat and cleaned up by *n*-hexane elution on a sulfuric acid-Celite 545 column; this procedure removes fats and oils. If additional cleanup is necessary, a standard Florisil column may be used. The hexane concentrate from the cleanup procedure is analyzed by a dehydrohalogenation-gas chromatographic procedure which gives a characteristic, reproducible pattern for dehydrohalogenated toxaphene. The 9 ft X 1/8 in. stainless steel chromatograhic column is packed with a 1:1 mixture of 5% SE-30 on Gas Chrom Q and 5% DC-710 Silicone Oil on 100-120 mesh Gas Chrom Q. The column should be conditioned for at least 2 days at 250°C while passing nitrogen carrier gas through it. An electron capture detector is recommended. A Varian-Aerograph Model 660 instrument with an electron capture detector is recommended for unmodified toxaphene. The 5 ft X 1/8 in. o.d. glass column should be packed with 1.3 gm of 3.8% UCW-98 on 80-100 mesh Diatoport S.

75-2810. Buxton, R. W.; Ja, W. Y.; McKay, J. C. (Stauffer Chem. Co., Western Res. Cent., Richmond, CA). **Trithion.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 519-528. (3 references)

Liquid emulsifiable concentrates of Trithion (carbophenothion) are diluted to an appropriate concentration with carbon disulfide and granular formulations and dusts are extracted with carbon disulfide-chlorform-acetone. The Trithion is then analyzed by flame ionization gas chromatography equipped with a 1.5 ft X 0.25 in. o.d. (0.16 in. i.d.) Pyrex glass column packed with 12% SE-30 on 80-100 mesh Gas Chrom Q. Imidan (phosmet) is used as an internal standard. Trithion residues are extracted with aqueous acetonitrile or hexane plus acetonitrile and cleaned up with alumina and Nuchar shakeouts. Trithion and three of the metabolites are then oxidized to the two sulfones, further cleaned up, and separated on a silica gel column. Determination is by gas chromatography using flame photometric detection in the phosphorus mode. The 900 mm X 2 mm i.d. acid-washed and silanized Pyrex column is packed with 10% OV-1 on 100-120 mesh Gas Chrom Q; a second column packed with 12% QF-1 on 100-120 mesh Gas Chrom Q may be used to confirm the identity of the thion sulfone or the oxon sulfone. The detection limit of the method is 0.002 ppm of the thion sulfone and 0.02 ppm of the oxon sulfone; recovery of the thion sulfone ranges from 80 to 100% and recovery of the oxon sulfone ranges from 90 to 120% from fruits and dry beans and from 70 to 90% from oily mataerial.

75-2811. Shell Development Company. (Modesto, CA). **Vapona insecticide.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 529-541.

Formulations of Vapona insecticide (dichlorvos, DDVP) are extracted or diluted with chloroform. Certain formulations containing low concentrations of DDVP in aliphatic hydrocarbon solvents required partitioning of the DDVP into acetonitrile. Analysis is by gas chromatography using a flame ionization or thermal conductivity detector. DDVP can be satisfactorily chromatographed on 4 ft X 1/4 in. stainless steel columns containing 5-10% of the silicones SE-30, UC W-98, DC-200, or OV-1 on 80-100 mesh Gas Chrom Q. The precision of the method is estimated to be ±4% of the mean. Food, beverages, animal tissue, blood, and agricultural crops containing dichlorvos residues are extracted with ethyl acetate, while air containing such residues is drawn through an impinger containing ethyl acetate. If oily, the extracts are then treated with activated carbon and calcium stearate. Determination is on a gas-liquid chromatograph equipped with a phosphorus detector and a 4 ft X 1/8 in. stainless steel column packed with a 1:1 mixture of 2% Reoplex 400 and 10% QF-1 on 80-100 mesh Chromosorb W-HP. The limit of detection is 0.02 ppm in food and crops and down to 0.01 μg/l. in air.

75-2812. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Zectran.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 524-544. (3 references)

Residues of Zectran (mexacarb) on foliage are extracted with sulfuric acid, washed with ether then chloroform, and extracted with benzene. The benzene extract is reduced and diluted with a known volume of benzene. Analysis is on a gas chromatograph equipped with a reducing furnace, an electrolytic conductivity detector cell, and a 4 ft column packed with 80-100 mesh Gas Chrom Q coated with 10% DC-200 silicone oil. The inlet temperature is 225°C, and the column temperature is isothermal at 170°C for 2.3 min with a linear increase over the next 11 min to 250°C. The carrier gas (helium) flow is 83 ml/min at 30 psi and the hydrogen gas flow is 128 mg/min at 5 psi. The Zectran retention time is 3-4 min, three major breakdown products of Zectran giving peaks with about the same retention time. Zectran is determined by comparison of the peak height with a previously constructed standard curve. The sensitivity of the method is 0.1 ppm and Zectran at the 0.1-0.3 ppm level was recovered from foliage to the extent of 42-82%.

75-2813. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Captan and phaltan.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 546-549. (5 references)

Technical Captan and phaltan and their various formulations can be analyzed by gas-liquid chromatography using thermal conductivity detection or by selective hydrolysis followed by halide determination. With the former, the captan or phaltan sample is dissolved in acetone prior to analysis on an instrument equipped wih a 5 ft X 1/4 in. acid-washed and DMCS-treated glass column packed with 3% XE-60 on 80-100 mesh Chromosorb G. For the determination of captan residues on apricots, peaches, tomatoes, and cottonseed, the residues are extracted with benzene or acetonitrile and analyzed by electron capture gas chromatography on a 6 ft X 1.8 in. o.d. glass column packed with 10% DC-200 on 110-120 mesh Anakrom ABS. The average recovery is 92% and the limit of detection is 0.01 ppm. Captan, phaltan, and difolatan residues in crops can also be analyzed by electron capture gas chromatography following acetonitrile extraction, partitioning into methylene chloride-petroleum ether, and Florisil cleanup; recoveries were 80-100% at the 2.0-0.1 ppm level. A 4 ft X 1/4 in. spiral glass column packed with 3% Ge XE-60 has been successfully used to separate phaltan and captan at 195-200°C.

75-2814. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **2,6-Dichloro-4-nitroaniline (DCNA; Botran).** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 553-555. (4 references)

The recommended procedure for the determination of DCNA (dichloran) residues in fruits and crops involves benzene extraction, partitioning between acetonitrile and hexane, Florisil column cleanup, and analysis by microcoulometric gas chromatography. The 4 ft X 0.25 in. o.d. aluminum chromatographic column is packed with 5% DC-200 coated on 80-100 mesh Anakrom ABS. The column temperature is 150-160°C, the inlet block temperature is 175°C, the outlet block temperature is 175°C, the sample transfer line temperature is 180°C, the furnace temperature is 820°C, and the inlet temperature is 220°C. The nitrogen carrier gas flow rate is 55 ml/min at 20 psi. Recoveries from all samples fortified at 0.1-10 ppm were 80% or better. The method may be applied to the analysis of residues in cherries, garlic, lettuce, scallions, soils, onions, peaches, and strawberries.

75-2815. Crossley, J. (Ortho Div., Chevron Chem. Co., Richmond, CA). **Difolatan.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 556-560. (1 reference)

Difolatan formulations can be dissolved in acetone and analyzed by gas-liquid chromatography using a 2 ft X

1/4 in. glass column packed with 5% QF-1 on 60-80 mesh Chromosorb G. The column temperature is 260°C, the injector and detector temperatures are 270°C, and the carrier gas is helium. Difolatan residues are extracted from the sample with benzene. Certain crops, such as apples, celery, grapes, peaches, and tomatoes, with difolatan residue levels greater than 5 ppm need no cleanup. In all other cases, cleanup by thin-layer chromatography alone or in combination with column chromatography/ acetonitrile partitioning is required. Determination is by electron capture gas chromatography. The 2 ft X 1/8 in. acid-washed and DMCS-treated column is packed with 5% QF-1 on Chromosorb G, 60-80 mesh. The column temperature is 190°C with a nitrogen carrier gas flow of about 40 ml/min. Under these conditions, difolatan has a retention time of 2 min; none of 27 other pesticides tested for interference in the chromatographic step eluted at the same time as difolatan.

75-2816. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Dithiocarbamates.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 561-563. (4 references)

Dithiocarbamate fungicides are nonvolatile compounds which are not subject to gas chromatography intact. Fragments such as carbon disulfide can, however, be determined by gas chromatography. For the determination of 3.5-7 ppm of dithiocarbamates (e.g., ferbam) in foods, 10 *N* sulfuric acid was added to the sample and allowed to stand at 60°C for 30 min. The carbon disulfide thereby evolved was determined by injecting the head-space gas into a 6 ft X 0.25 in. column containing 10% SE-30 on 100-200 mesh Chromosorb W at 60°C with a nitrogen carrier gas flow of 60 ml/min. Detection was with a flame photometric detector and recoveries greater than 80% were obtained. Ethylene bisdithiocarbamates (e.g., maneb) require 1.5% stannous chloride in 4 *N* HCl in place of sulfuric acid for carbon disulfide evolution. Zineb, maneb, and nabam can also be analyzed based on the thermal release of ethylene thiourea, which is detected on an F & M Model 1609 flame ionization chromatograph with a modified flow system. The 6 ft X 0.25 in. glass coil column is packed with 4% QF-1 on 80-100 mesh HMDS Chromosorb W at 180°C. Colorimetric procedures can also be used to determine dithiocarbamate residues.

75-2817. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Dyrene.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 564-566. (3 references)

Dyrene residues in strawberries, potatoes, tomatoes, and cucumbers are extracted with acetonitrile and partitioned to hexane. For confirmation, dyrene in the presence of the plant extractives is reacted with methanolic sodium hydroxide; this treatment converts the dyrene to two major products with longer retention times on the gas chromatograph. The recommended instrument is an Aerograph Hi-Fy Model 550 equipped with an electron capture detector and two columns packed with SE-30 plus QF-1 on Chromosorb W, respectively. The column temperature is 208-212°C, the inlet temperature is 50 ml/min. Recoveries were more than 80% for strawberries fortified at 20 ppm, potatoes and tomatoes fortified at 10 ppm, and cucumbers fortified at 5 ppm. No interferences are provided by atrazine, propazine, simazine, captan, *p,p'*-DDT, heptachlor epoxide, or malathion.

75-2818. Zweig, G.; Sherma, J. (Life Sci. Syracuse Univ. Res. Corp., Syracuse, NY). **Karathane (dinocap).** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 568-574. (5 references)

For the formulation analysis of technical Karathane (dinocap), a weighed amount of internal standard (4,6-dinitro-*o*-cresol) is added to the sample, the mixture is diluted with nitrobenzene, and the solution is analyzed by temperature-programmed gas-liquid chromatogaphy. The recommended instrument is an F & M Model 800 equipped with a hydrogen flame ionization detector, a 1 mV strip chart recorder, and 8 ft X 4 mm i.d. dual glass columns packed with 3% QF-1 silicone oil on 60-80 mesh Gas Chrom Q. For the formulation analysis of Karathane WD, the active ingredients are extracted from the inert carrier with 2% formic acid in chloroform in a semimicro Soxhlet extraction apparatus. The extraction solvent is then removed, the internal standard is added, and the mixture is diluted with nitrobenzene. The active ingredient content is then determined as above.

75-2819. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **PCNB.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 577-580. (6 references)

PCNB can be measured in dusts by gas chromatography using diisobutyl phthalate as an internal standard and a stationary phase of 15% ABS on Celite 545. For analysis of PCNB residues, the samples are extracted with hexane, interferences are removed by hexane elution on a silicic acid column, and the PCNB is determined by electron capture gas chromatography. The 4 ft X 1/4 in. o.d. U-shaped stainless steel column is packed with 2% SE-30 coated on 90-100 mesh Anakrom ABS. The column temperature is 170°C, the injection port temperature is 220°C, the detection temperature is 210°C, and the nitrogen carrier gas flow rate is 160 ml/min. The retention time for PCNB is 94 sec. Recoveries from different samples fortified at 0.010-0.279 ppm averaged from 74% for leaf let-

tuce to 119% for peanut hay. Using this procedure, PCNB can be determined in celery, flax seed, lettuce, peanuts, peanut hay, peanut shells, potatoes, radishes, strawberries, and soil.

75-2820. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Pentachlorophenol (pCP).** *IN: Analytical methods for Pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 581-583. (6 references)

A method is recommended for the analysis of pentachlorophenol (PCP) residues in human urine. The urine is mixed with concentrated sulfuric acid, then shaken with petroleum ether. Isopropyl alcohol is added, the aqueous phase is separated and shaken with a second portion of petroleum ether, and the extraction procedure is repeated. The petroleum ether fractions are combined and washed with distilled water, then evaporated. The resulting PCP residues are dissolved in diazomethane solution, the solvent is removed, and the residue is dissolved in petroleum ether. This solution is analyzed by electron capture gas chromatography using a 6 ft X 0.25 in. glass column packed with 5% QF-1 on 100-200 mesh Gas Chrom Q. The inlet temperature is 180°C, the column temperature is 145°C, the detector temperature is 193°C, and the nitrogen flow rate is 70 ml/min. The lower limit of detection with this procedure is 3-10 ppb PCP and recoveries of PCP from urine fortified with 0.5 μg averaged 91.6% with a range of 81-100%.

75-2821. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse NY). **Phygon (dichlone).** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 584-585. (2 references)

For the analysis of phygon (dichlone) residues in field-treated crops, the samples are macerated and extracted with benzene, and the extracts are dried over anhydrous sodium sulfate. For crops such as cherries, peaches, and apricots, a Florisil cleanup procedure may be required to purify the benzene extracts. Analysis is by electron capture gas chromatography on an Aerograph HY-FI Model 600B or equivalent with a 5 ft X 1/8 in. o.d. glass column pakced with 5% QF-1 on 70-80 mesh Chromosorb G-AW-DMCS. The standard curve of a freshly prepared benzene solution of phygon was linear over a range of 0.3-5.0 ng phygon, the latter eluting in just under 6 min. Since prolonged storage and exposure to sunlight lead to degradation and conversion of the phygon, samples must be analyzed as quickly as possible after extraction; even under ideal conditions, however, some phygon will be found as phthalic acid. Recovery was 50% from samples fortified at 0.01 ppm and about 90% from samples fortified at 1.0 ppm; recovery decreases as the length of time between extraction and analysis is increased.

75-2822. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Amiben.** *IN: Analytical Methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 588-595. (3 references)

No gas chromatographic method has been developed for the formulation analysis of amiben. However, a simplified method for the analysis of amiben residues in crops has been developed based on a colorimetric residue procedure. The sample is mixed with 3% sodium hydroxide in methanol, extracted with 20% sulfuric acid, and reextracted with ether. The extract is acidified with 6 *N* hydrochloric acid and methylated with diazomethane solution. Some crops, e.g., corn and corn silage, require further florisil cleanup. The amiben is then determined by microcoulometric gas chromatography using a 6 ft X 1/4 in. aluminum column packed with 3% FFAP on 60-80 mesh Chromosorb G, AW-DMCS at 225°C. The method has been successfully used on dry beans, bean vines, lima beans, peanuts, peanut forage, peppers, pumpkins, soybeans, soybean foliage, summer and winter squash, sweet potatoes, tomatoes, and field corn. Good recoveries were obtained with crops fortified at 0.1 ppm; a realistic limit of detection is 0.04 ppm.

75-2823. Zweig, G.; Sherma, J. (Life Sci. Div., Syracuse Univ. Res. Corp., Syracuse, NY). **Atratone.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VI, Gas chromatographic analysis.* G. Zweig and J. Sherma, Eds., Academic Press, New York, 1972, p. 597-599. (1 reference)

For the determination of atratone residues in soils and crops, a second related triazine (e.g. prometone) is added to the sample, which is then extracted with methanol, dichloromethane, and ammonia solution. Determination is on a Pyr-Agron chromatograph or equivalent equipped with a 4 ft glass column packed with 0.1% liquid phase of ethylene glycol adipate polyester on glass beads. The beads are precleaned with alkaline potassium permanganate. The column temperature is 140°C and the argon flow rate is 50 ml/min. The atratone and prometone peaks appear 20-25 min after injection; the relative retention of prometone to atratone is 0.83. The limit of detection is better than 0.1 ppm for atratone and other herbicides tested. Complete recoveries were obtained from various types of soils and sands and fortified samples were kept for 18 hr at room temperature before analysis without any adverse effects on recovery. Other triazines can be determined by the same method by choosing an internal standard which will have a peak separated from, but fairly close to, the residue of interest.

75-2824. Suzuki, K.; Nagayoshi, H.; Kashiwa, T. (Agric. Chem. Inspect. Stn., Min. Agric. Forestry, Kodairashi, Tokyo, Japan). **The systematic separation and identification of pesticides in the second and third division.** *Agric. Biol. Chem. (Tokyo)* 38(8): 1433-1442; 1974. (6 references)

The systematic identification and determination of many kinds of pesticides were attempted by a combination of column, thin-layer and gas chromatography. Twenty-one pesticides in the second division, e.g., α-, β-, γ-, δ-BHC, trifluralin, CPA, nitrofen, endrin, dieldrin, dicofol, etc. were separated from 15 pesticides in the third division, e.g., dichlone, EPN, anilazine, chloropropylate, chlorpropham, folpet, barban etc., and pesticides in the third division were also separated from those in the fourth division, e.g., trietazine, prometryne, propazine, atrazine, BPMC, carbaryl etc. by column chromatography. Furthermore, those pesticides in the second and third divisions were separated from each other and determined by gas chromatography with ECD, FTD, and FID after division into 4 groups by TLC. Most of these pesticides were more than 90% recovered through the whole procedure. (Author abstract by permission)

75-2825. Marek, V.; Ondrej, M. (Nat. Tech. Inst. Soil Sci. Sumperk-Temenice, Czechoslovakia). **Biologicky dukaz benomylu v rostlinnych tkanich hrachu a jeho morici ucinnost. [Biological demonstration of the presence of benomyl in tissues of pea plants and its systemic effectiveness.]** *Agrochemia* 13(8): 230-233; 1973. (10 references) (Czech)

Seeds, leaves, and roots of Raman pea plants were analyzed for the presence of benomyl and for its effectiveness as a fungicide. Test plants were grown from seeds soaked for 24 hours in a solution of 29.3 mg of benomyl per 100 ml of water. The same solution was also applied to roots of plants grown from normal seeds. The presence of benomyl in plant tissues was measured by a bioassay in which the inhibition of growth of *Penicillium claviforme* by methyl alcohol extracts of plant tissues was observed. Another semi-quantitative test for the presence of benomyl, or of its hydrolysis product MBC, involved a spectral analysis of methyl alcohol solutions of extracts of the plant tissues, using ultraviolet light absorption at 282 nm. It was established that the bioassay is more suitable for identifying benomyl concentrations from 0.5 mg/kg, whereas the spectral analysis can identify residues up to 1.0 mg/25 ml. Soaking of seeds in benomyl is much less effective than direct application to roots, which then transport it to the upper parts of the plant. Benomyl-soaked seeds have a significantly lower germination rate than water-soaked or thiram-soaked seeds (67% versus 95-98%). In low concentrations (less than 0.05%) benomyl stimulates growth of roots and of the entire plant. Concentrations higher than 0.01% are required for effective fungicide activity.

75-2826. Hurley, J. T. (State of Illinois Environ. Protect. Ag., Springfield, IL). **Pesticide analysis in water.** *J. Amer. Water Works Assoc. J.* 66(1): 27-31; 1974.

The analysis of water samples for pesticide residues is discussed. Among the aspects of importance in investigating the levels and types of pesticides in water are toxicity, extent of usage, persistence in the environment, biomagnification, and sensitivity of detection. Among the most important classes of pesticides are the chlorinated hydrocarbon and organophosphorus pesticides, carbamates, and phenoxy herbicides. Analysis of water samples for chlorinated hydrocarbons involves: extraction with an organic solvent; column chromatography cleanup and separation; and electron-capture gas chromatographic analysis. The gas chromatograph system consists of five basic parts: the pressure regulators and flowmeter for the carrier gas; a sample-injection system; the column; the detector; and the recorder. The resulting chromatograms can be used for qualitative and quantitative determinations, relative identification being obtained from retention-time comparisons with standards and quantitative determinations being obtained by peak-height or area comparison with standard pesticides. With the electron capture detector, gas chromatogaphy can be used to detect residue levels as low as 10 pg (less than 1 ppt). Other substances in addition to pesticides will be detected by an electron-capture detector; these include the PCBs and phthalate esters. Results of pesticide analyses to date indicate that the water supplies investigated have only trace amounts of chlorinated hydrocarbon pesticides present; many single pesticides are present in concentrations of less than 1 ppt, which is considerably below the proposed EPA drinking-water standards.

75-2827. Ahnoff, M.; Josefsson, B. (Dep. Anal. Chem., Univ. Gothenburg, Fack, Goteborg, Sweden). **Simple apparatus for on-site continuous liquid-liquid extraction of organic compounds from natural waters.** *Anal. Chem. (London)* 46(6): 658-663; 1974. (26 references)

A continuous liquid-liquid extraction apparatus based on mixed settling is described for the extraction of organic compounds from natural waters under field conditions. The organic refreshing system normally used in liquid-liquid extraction is eliminated to simplify the routine for field application and improve efficiency. The extraction of lindane, aldrin, DDE plus dieldrin, DDT, and DDD (TDE) from distilled water under laboratory conditions was studied and the method was used to quantitate the PCBs in river water under field conditions. In laboratory tests, the recovery rate was 83-96% depending on the pesticide and pump rate. Extraction of PCB from the river water with different multichamber arrangements followed by electron-capture gas chromatography revealed PCB concentrations in the range 0.1-1.0 ng/l. The theory for extracting chlorinated pesticides continuously from water with a stationary immiscible solvent is discussed.

75-2828. Gegiou, D. (Exp. Res. Dep., Gen. State's Lab., Athens, Greece). **Analysis of 1,2,3,4,10,10 - hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4-endo-exo-5,8-dimethanonaphthalene by nuclear quadrupole resonance spectrometry.** *Anal. Chem. (London)* 46(4): 742-743; 1974. (6 references)

Aldrin was analyzed by nuclear quadrupole resonance (NQR) spectrometry at 77° K, 193° K, 273° K, and

300° K. At room temperature (300° K), aldrin exhibited three resonance signals, while at the lower temperatures the expected six signals were observed. No evidence of a phase transition or discontinuity in the plot were found when the pure NQR frequencies were plotted as a function of temperature. The two highest frequency signals at 77° K are probably attributable to the two chlorine atoms of the dichloromethylene group. The remaining two signals can be tentatively attributed to the chlorine atoms on the bridgehead carbon atoms.

75-2829. Shackelford, W. M.; Guilbault, G. G. (Dep. Chem., Univ. New Orleans, New Orleans, LA 70122). **A piezoelectric detector for organophosphorus pesticides in the air.** *Anal. Chim. Acta* 73(2): 383-389; 1974. (7 references)

Piezoelectric crystal detectors for organophosphorus compounds have previously utilized metal complexes of the pesticides as absorptive substrates. Although useful as detectors, these metal complexes often lacked the desired sensitivity. As substances which have demonstrated reactivity toward cholinesterase inhibitors, oximes were studied as potentially more sensitive substrates for these detectors. AT-cut quartz crystals with fundamental frequencies of 9.0 MHz were coated with oxime substrates and incorporated in mixer circuits to allow read-out by either an ammeter or a recorder. The crystals proved selective, relatively durable, and sufficiently sensitive to allow detection of organophosphorus pesticides at levels of less than 10 ppb. This detector has potential for use as both an air pollution sensor and a highly selective gas chromatography detector.

75-2830. Gibson, K.; Guilbault, G. G. (Chem. Dep. A, Tech. Univ. Denmark, Lyngby, Denmark). **A potentiometric assay of cholinesterase.** *Anal. Chim. Acta* 76(2): 245-251; 1975. (17 references)

Two rapid and practical methods for the assay of cholinesterase activity are described. They are based on the fact that under certain conditions the enzymatic reaction can result in a time-dependent linear change in pH. By choosing tris(hydroxymethyl) aminomethane (tris, p*K*a ≈ 8.1) as the buffer, and by running the reaction at pH 8.2-7.9, the initial rate of the enzyme reaction can be obtained from the straight line response of pH vs. time. Two methods are proposed: the first is a static semiautomatic method capable of doing up to 12 assays per hr; and the second is an automated continuous flow approach which can do up to 40 assays per hr. These methods are comparable in speed to automated spectrophotometric methods, and the precision obtained (2.6%) is better than that obtained with the spectrophotometric method (5.0%). They do, however, have limitations in that factors other than the hydrolysis of acetylcholine may result in a change in the pH of the very weak buffer used. The absorbance of atmospheric carbon dioxide by the buffer is a second potential problem source which would prevent the use of this apparatus for dibucaine inhibition studies.

75-2831. Federal Working Group on Pest Management. (Washington, DC 20460). **Guidelines on analytical methodology for pesticide residue monitoring.** *EPA, Washington, DC,* 1975, 54 p.

Guidelines are provided as an aid to analytical laboratories in the selection and modification of methods and the collection of valid data for pesticide residue monitoring. Safety, sampling, storage of samples, solvents and reagents, extraction, cleanup, detection and quantitation by gas chromatographic and other methods, confirmation of residue identity, sensitivity and limit of detection, losses and degradation of pesticides, statistical evaluation and reporting of results, metabolites and degradation products, and multicomponent pesticides and PCBs are discussed. Sources and preparation of pesticide standards are also discussed. In addition, reference materials of general interest are listed, and the more widely referenced manuals are identified with appropriate notes on their applicability availability, and contents.

75-2832. MaCuaig, R. D. (FAO/SIFA Locust Project, Desert Locust Control Organization Eastern Africa, Addis Ababa, Ethiopa). **Radiometric estimation of blood cholinesterase levels in domestic animals.** *Int. J. Appl. Radiat. Isotopes* 26(6/7): 381-385; 1975. (5 references)

The estimation of blood cholinesterase provides a valuable indication of an animal's degree of exposure to cholinesterase-inhibiting chemicals, as it is possible to have depression of activity in the complete absence of external symptoms. A radiometric method has been adapted for measuring domestic animal blood cholinesterase activity and its inhibition as an index of possible exposure to organophosphorus or carbamate insecticides under field conditions. Small samples of blood are diluted (not more than 11-fold), hemolyzed, and incubated on a glass slide with 0.05 m*M* (1-^{14}C) acetylcholine as substrate. After about 40 seconds, the reaction is stopped and the volatile (^{14}C) acetate formed is enzymically removed by drying. The enzymatic hydrolysis rate is calculated from the fraction of radioactive substrate remaining under standardized conditions. Both Geiger-Mueller and scintillation counting gave repeatable results without too much scatter; there was no reason to choose one above the other, although the methods appeared to give slightly different results. As Geiger-Mueller counting was simpler to carry out, this method was used. Varying the blood dilution or reaction time within the narrow limits selected had no significant effect on the calculated hydrolysis rates. The scatter of these results was greater than desirable and all efforts to reduce this have failed. However, the scatter was not sufficient to prevent blood cholinesterase measurements from being made.

75-2833. Launer, J. E. (Lab. Serv., Oregon Dep. Agric., Salem, OR 97310). **Collaborative study of the gravimetric method for the determination of mercury in chlorinated pesticide formulations.** *J. Assoc. Off. Anal. Chem.* 58(1): 33-34; 1975. (4 references)

The official first action AOAC gravimetric method for mercury, 6.C01-6.C03, and the official CIPAC titrimetric method, M2.3, were collaboratively studied by 4 CIPAC laboratories, using the same 4 samples analyzed by AOAC collaboration in 1972. Averages at the 3.7 and 3.4% level were the same by both methods whereas the CIPAC method produced, on the average, 4% higher results, all levels included. The AOAC method performed well in the presence of copper and chlorinated pesticides and is less complex to use than the present CIPAC method for mercury in these mixtures. The method has been adopted as official final action. (Author abstract by permission)

75-2834. Pease, H. L. (Biochem. Dep., E. I. du Pont de Nemours & Co., Inc., Wilmington, DE 19898). **Collaborative study of a method for the analysis of dry methoxychlor formulations.** *J. Assoc. Off. Anal. Chem.* 58(1): 40-43; 1975. (4 references)

A collaborative study has been completed on a method for determining methoxychlor content in dry formulations. The method is based on a total halogen determination plus a selective, qualitative thin layer chromatographic (TLC) measurement to establish that *p,p'*-methoxychlor is the primary halogen-containing organic species present in the formulation. After extraction of the sample with toluene, the toluene solution of methoxychlor is treated with sodium biphenyl to convert all halogen to the halide. The halide is then extracted with a solution of nitric acid and titrated with silver nitrate according to the Volhard procedure or potentiometrically, using a pH meter assembly. Based on the results obtained from 7 collaborators, the standard deviation of the method is about 0.48% at the 50% level. The qualitative TLC measurement is made on an aliquot of the initial toluene extract, using a selective halogen detection system. The method has been adopted as official first action. (Author abstract by permission)

75-2835. Van Peteghem, C. H.; Heyndrickx, A. M. (Dep. Toxicol., State Univ. Ghent, Ghent, Belgium). **Spectroscopic properties of the methyl esters of chlorophenoxy acid herbicides.** *J. Assoc. Off. Anal. Chem.* 58(5): 1001-1012; 1975. (6 references)

The mass and infrared spectra of the methyl esters of nine chlorophenoxy acid herbicides are presented. Ultraviolet data are discussed and proton magnetic resonance spectra are tabulated. Because of the sensitivity of the technique, the mass spectra are most useful for the identification of those compounds in residues, especially by combined gas chromatography-mass spectrometry. The pure herbicides used for the recording of the spectra were obtained by synthesis and recrystallization. (Author abstract by permission)

75-2836. Reeder, S. K. (Product Res. Dev. Div., Sunkist Growers, Inc., Ontario, CA 91761). **High-speed liquid chromatographic determination of biphenyl residues in citrus products.** *J. Assoc. Off. Anal. Chem.* 58(5): 1013-1014; 1975. (5 references)

A simple, direct, and rapid method is given for the analysis of citrus oils for the fungistat biphenyl by high-speed liquid chromatography. The method is extended to orange juice and various "dry flavors" by an extraction procedure. Analytical limits are < 1 ppm without need for any cleanup or concentration steps.

75-2837. Ernst, G. F.; Roder, S. J.; Tjan, G. H.; Jansen, J. T. A. (Food Inspect. Serv., Utrecht, The Netherlands). **Thin layer chromatographic detection and indirect gas chromatographic determination of three carbamate pesticides.** *J. Assoc. Off. Anal. Chem.* 58(5): 1015-1019; 1975. (13 references)

Carbamate pesticide residues are extracted from vegetables and fruits with methylene chloride. The extracts are spotted on silica gel plates and the pesticides are detected by an enzymatic inhibition technique. For quantitative determination, aliquots of the methylene chloride extracts are evaporated to dryness in a rotary evaporator. After the residues are dissolved in ethanol, 0.5*N* NaOH is added in the hydrolysis step. To remove a number of possible interferences the hydrolyzed phenols are steam-distilled and treated with 1-fluoro-2,4-dinitrobenzene and/or 4-chloro -α,α,α- trifluoro -3,5- dinitrotoluene to form the ether derivatives. Efficiency in the conversion of the phenolic moieties to the phenyl ethers is about 100%. The resulting electron-capturing derivatives enable the carbamate pesticides to be detected in vegetables and fruits at the 0.05 ppm level. Recoveries of 90-94% were obtained from vegetables and fruits fortified with 0.5-2.0 ppm carbaryl, Mesurol (methiocarb), and propoxur. (Author abstract by permission)

75-2838. Luke, M. A.; Froberg, J. E.; Masumoto, H. T. (Food and Drug Admin., Los Angeles, CA 90015). **Extraction and cleanup of organochlorine, organophosphate, organonitrogen, and hydrocarbon pesticides in produce for determination by gas-liquid chromatography.** *J. Assoc. Off. Anal. Chem.* 58(5): 1020-1026; 1975. (20 references)

A rapid, multiresidue procedure utilizing the minimal cleanup necessary for gas-liquid chromatographic (GLC) analysis is presented. The samples are extracted with acetone and partitioned with methylene chloride-petroleum ether to remove water. The organophosphorus and organonitrogen compounds are then quantitated by

GLC, using a KCl thermionic detector. A Florisil cleanup of the extract is performed prior to the determination of organochlorine compounds by a GLC electron capture detector. Carbon-hydrogen compounds such as biphenyl and *o*-phenylphenol undergo the Florisil cleanup and may also be quantitated by GLC. Quantitative recoveries for 15 organophosphorus, 9 organochlorine, 5 organonitrogen, and 2 hydrocarbon pesticides show the range in polarities of pesticides recovered, from Monitor (methamidophos) to biphenyl. The method is simple and fast with a great potential for the analysis of many more compounds. (Author abstract by permission)

75-2839. Khan, S. U. (Chem. Biol. Res. Inst., Canada Agric., Ottawa, Ontario, Canada). **Electron capture gas-liquid chromatographic method for the simultaneous analysis of 2,4-D, dicamba, and mecoprop residues in soil, wheat, and barley.** *J. Assoc. Off. Anal. Chem.* 58(5): 1027-1031; 1975. (10 references)

A method has been developed for the simultaneous analysis of 2,4-D (2,4-dichlorophenoxyacetic acid), dicamba (2-methoxy-3,6-dichlorobenzoic acid), and mecoprop (MCPP; 2-[(4-chloro-*o*-tolyl) oxy] propionic acid) residues in soil, wheat, and barley. Soil and crop samples are extracted with acidic acetone and methanol, respectively. The extracts in diethyl ether are esterified with diazomethane and cleaned up by passing through a Florisil column. Extracts are analyzed by gas-liquid chromatography, using an electron capture detector to determine 2,4-D and dicamba residues. Mecoprop in the extract is not detected at low levels of concentration. However, bromination of the extract increases the response of the electron capture detector to mecoprop. The method is sensitive to about 0.05 ppm 2,4-D and dicamba and 0.5 ppm mecoprop. Recoveries of these 3 herbicides added to soil, wheat, and barley samples at 0.05, 0.1, 0.5, and 1.0 ppm levels were between 65 and 93%. The method was used for the simultaneous analysis of 2,4-D, dicamba, and mecoprop residues in wheat, barley, and soil samples obtained from fields sprayed with the herbicide formulation Kil-Mor. (Author abstract by permission)

75-2840. Simonaitis, R. A.; Cail, R. S. (Stored-Product Insects Res. Dev. Lab., Agric. Res. Serv., U.S.D.A., Savannah, GA 31403). **Gas-liquid chromatographic determination of resmethrin in corn, cornmeal, flour, and wheat.** *J. Assoc. Off. Anal. Chem.* 58(5): 1032-1036; 1975. (7 references)

A gas-liquid chromatographic (GLC) method was developed for the determination of residues of resmethrin ((5-benzyl-3-furyl) methyl *cis-trans*-(±)-2,2-dimethyl-3-(2-methylpropenyl)-cyclopropanecarboxylate) in corn, cornmeal, flour, and wheat. The commodity, fortified with resmethrin, was extracted by tumbling with pentane and transferred to acetonitrile, the fat was partitioned off, and the sample was chromatographed with 3% ethyl acetate in pentane on Florisil containing 0.5% water. The resmethrin residue was determined by GLC with a flame ionization detector. The results were compared with known standards that had undergone the same cleanup procedures. The method was sensitive to concentrations of resmethrin to 0.2 ppm, recoveries averaged 83%, and reproducibility was good. (Author abstract by permission)

75-2841. Thompson, J. F.; Mann, J. B.; Apodaca, A. O.; Kantor, E. J. (Health Effects Res. Lab., EPA, Research Triangle Park, NC 27711). **Relative retention ratios of ninety-five pesticides and metabolites on nine gas-liquid chromatographic columns over a temperature range of 170 to 240°C in two detection modes.** *J. Assoc. Off. Anal. Chem.* 58(5): 1037-1050; 1975. (7 references)

Tables of relative retention data are presented for 95 organochlorine and organophosphorus pesticidal compounds at column oven temperatures from 170 to 204°C in 2° increments. Retention values, relative to aldrin or parathion (RRT), were found to vary inversely with increasing column temperature for all compounds eluting later than the reference compounds, and in direct proportion for those compounds eluting earlier than the fixed reference compound. Studies revealed a linear relationship between column temperature and relative retention ratios; thus, by obtaining precise values by gas-liquid chromatography for a number of pesticidal compounds at 170, 185, and 200°C, a computer program was developed to obtain RRT values at all 2° increments from 170 to 204° C, the customary limits in the gas-liquid chromatography of pesticides. The tables are valuable in the tentative identification of pesticidal peaks resulting from the chromatography of sample extracts for multiresidue assessment. (Author abstract by permission)

75-2842. Cochrane, W. P.; Lawrence, J. F.; Lee, Y. W.; Maybury, R. B.; Wilson, B. P. (Anal. Serv. Sect., Plant Products Div., Agric. Canada, Ottawa, Ontario, Canada). **Gas-liquid chromatographic determination of technical chlordane residues in food crops: interpretation of analytical data.** *J. Assoc. Off. Anal. Chem.* 58(5): 1051-1061; 1975. (11 references)

An interlaboratory investigation of technical chlordane residues in food crops was carried out to determine the most practical and consistent method of reporting results. Using a technical chlordane reference standard, eight gas chromatographic stationary phases were studied for their resolution capabilities. The best separations were obtained with SE-30 and its OV-1 equivalent. Using these columns and electron capture detection, potatoes and carrots from supervised field experiments were analyzed in duplicate and quantitated by using four methods of calculation. The data were statistically treated to determine the precision and bias for each method. Also, one sample was analyzed in duplicate on two different occasions by six laboratories to substantiate the initial conclusions. Based on the criterion of high precision it is suggested that a comparison of total area under the chromatogram of the

sample with total area of a standard technical chlordane specimen be the method of quantitation. Only peaks which are common to both standard and sample have any significance in this type of calculation. (Author abstract by permission)

75-2843. Kapila, S.; Aue, W. A. (Chem. Dep., Dalhousie Univ., Halifax, Nova Scotia, Canada). **Voltage effects in a d.c. electron capture detector.** *J. Chromatogr.* 108(1): 13-21; 1975. (5 references)

The effects of various constant potentials on reaction and response of typical model compounds were measured by a commercial electron capture detector (ECD). The effluents from this detector were separated by a second gas chromatographic column and detected by a second ECD. This arrangement made it possible to distinguish between the parent substances and their products (where such could be detected), and to estimate how much of the parent substance had been consumed in the first ECD. Model substances included a variety of biologically active compounds that are usually determined by electron capture gas chromatography, such as chlorinated hydrocarbon insecticides. While all compounds shared a common voltage profile pattern, product formation depended on the individual structures. Potential mechanistic and analytical uses of the simple dual-channel system are indicated. (Author abstract by permission)

75-2844. Kathpal, T. S.; Dewan, R. S. (Pestic. Res. Lab., Dep. Entomol., Univ. Udaipar, Udaipur, India). **Improved cleanup technique for the estimation of endosulfan and endrin residues.** *J. Assoc. Off. Anal. Chem.* 58(5): 1076-1078; 1975. (8 references)

An improved cleanup technique has been developed for the extraction of endosulfan and endrin from crops. The technique involves the use of Nuchar C-190N as adsorbent and a mixture of *n*-hexane and acetone (4) as the eluting solvent. The mean percentage recoveries of endosulfan (I and II) and endrin from plant tissue extracts fortified at levels of 0.5-2.0 ppm varied from 86 to 102 and 97 to 100, respectively. (Author abstract by permission)

75-2845. MacNeil, J. D.; Hikichi, M. (Agric. Can., Res. Stn., Summerland, British Columbia, Canada). **A rapid method for the quantitative analysis of benomyl on cherries by thin-layer chromatography and in situ fluorometry.** *J. Chromatogr.* 101(1): 33-37; 1974. (13 references)

The in situ analysis of benomyl (methyl 1-(butylcarbamoyl) benzimidazole-2-ylcarbamate) on thin-layer chromatograms by fluorescence scanning was investigated. A linear relationship between peak area and concentration range was found for 50-500 ng per spot, with a slight change in slope observed at high concentrations. Concentrations as low as 20 ng per spot could be detected instrumentally, but not quantitatively. Reproducibilities of ± 10% or better can be expected in the concentration range 200-800 ng per spot. The technique was applied to the analysis of commercially treated cherries and proved sensitive to less than 1 ppm of benomyl by weight on the sample surface. This analytical approach is more rapid than other published methods. (Author abstract by permission)

75-2846. Mukherjee, G.; Mukherjee, A. K.; Roy, B. R. (Cent. Food Lab., Calcutta, India). **Estimation of propoxur in formulation.** *J. Food Sci. Technol. (Mysore)* 12: 96-97; 1975. (2 references)

A colorimetric and thin layer chromatographic method for the estimation of propoxur is described. The colorimetric procedure, which is based on the alkaline hydrolysis of propoxur and its coupling with diazotized sulfanilic acid, is simple and sensitive; it does not differentiate between propoxur and its hydrolysis products. The propoxur is mixed with 10% KOH, boiled, and cooled. Water and a diazotized sulfanilic acid solution are added to the sample, and color formation takes place immediately. The color formation follows Beer's Law within a range of 0.1-10 mg propoxur. The thin-layer chromatographic procedure uses a thin layer plate of aluminum oxide with ethyl ether-toluene as the mobile solvent. After evaporation of this solvent, the plate is sprayed with 20% alcoholic KOH and diazotized sulfanilic acid; fine orange spots appear immediately. This spots are scraped into tubes containing 10% alcoholic KOH and the intensity of the color is measured with a photoelectric colorimeter or photoelectric densitometer.

75-2847. Martens, M. A.; Heyndrickx, A. (Dep. Toxicol., State Univ. Ghent, Ghent, Belgium). **Analysis of paraquat in aqueous solutions by pyrolysis gas chromatography.** *J. Pharm. Belg.* 29(5): 444-448; 1974. (4 references)

A method of analysis for paraquat is presented. The dichloride of the cation is dissolved in distilled water and injected into the gas chromatograph with an injection port temperature of 400°C. Through pyrolysis, paraquat is demethylated and the resulting 4,4'-bipyridine is chromatographed. Various chromatographic columns were tested on which OV 225 6.1% with 2% NaOH on chromosorb W A.W. D.M.C.S. yielded the best results. This technique allows determination of paraquat dichloride directly in water and diluted commercial solutions. Fairly good results are obtained with a detection limit of 1 ng paraquat dichloride.

75-2848. Martens, M. A.; Heyndrickx, A. (Dep. Toxicol., State Univ. Ghent, Ghent, Belgium). **Determination of paraquat in urine by pyrolysis gas chromatography.** *J. Pharm. Belg.* 29(5): 449-454; 1974. (3 references)

Paraquat is analyzed in urine by mixing the urine sample with a cation-exchange resin. The resin is washed with distilled water and two portions of 2*M* HCl, and transferred quantitatively into a microcolumn. The

paraquat is eluted out of the column by 6*M* HCl. The eluate is evaporated and the paraquat determined by pyrolysis gas chromatography. The recovery and the coefficient of variation of the whole analysis procedure were estimated on 5 urine samples of 5.0 ml, spiked with 20 ppm paraquat dichloride. The mean recovery was 95.4% with a total coefficient of variation of 11%. The detection limit is situated nearly at 0.1 ppm. Naturally, urines with much floating material must be filtered or centrifuged before starting the analysis; defecation with trichloroacetic acid is not required.

75-2849. Ali, K. A.; Nair, M. R. G. K. (Tamil Nadu Agric. Univ., Coimbatore, India). **Microbioassay of endrin residues on rice. 2. Determination of residues on rice plants.** *Madras Agric. J.* 60(7): 439-440; 1973. (6 references)

A new method of microbioassay involving the exposure of first instar larvae of *Corcyra cephalonica* St. to wheat flour media impregnated with micro doses of insecticide was adopted to measure the residues of endrin sprayed on rice plants. Dosage-mortality relationship between small doses of endrin contained in wheat flour breeding medium and the first instar larvae of *C. cephalonica* was determined by repeated trials for drawing a standard curve. Calculations of LD50s of replicated trials (1.81, 1.88, 178, and 1.78 ppm) proved the accuracy and reliability of the method. Endrin, when applied as emulsion containing 0.03% active ingredient on rice (IR 8) plants, left a residue of 183.36 ppm 24 hr after its application. The residues were subsequently 62.82, 47.22, 20.00, and 2.26 on the second, fourth, eighth, and sixteenth days, respectively.

75-2850. Woggon, H.; Jehle, D. (Zentralinst. Ernaehr. Bergholz-Rehbruecke, DDR). **Zur [On the determination of residues of biocidal organotin compounds by means of anodic stripping polarography.]** *Nahrung* 19(3): 271-275; 1975. (10 references) (German)

An improved anodic stripping polarographic method for the determination of organotin compounds, such as bis-(tributyltin)oxide and triphenyltin acetate, in surface water and other waters is described, and data on the toxicity and persistence of organotin pesticides is presented. After addition of hydrochloric acid, the water sample is steam distilled, and bis-(tributyltin)oxide is extracted from the distillate with cyclohexane for separation on a thin-layer chromatographic plate and visualization of the spots with quercetin in UV light. After elution with hydrochloric acid, determination is done by anodic stripping polarography, using UV radiation. Dealkylation products are extracted with chlorform, and sodium edetate is used for the extraction of triphenyltin acetate. The limit of detectability lies at 0.01 ppm. The recovery rate is 0.1 ppm for bis-(tribuyltin)oxide and 89% for 0.1 ppm triphenyltin acetate. Both compounds were found to be decomposed by UV light to alkylated and arylated products, and finally to tin. Both compounds are, however, highly toxic and rather persistent in water, and also in plants. Tributyltin compounds are much more persistent than triphenyltin derivatives.

75-2851. Maier-Bode, H.; Riedmann, M. (Pharmakol. Inst., Friedrich Wilhelms Univ., Bonn, Bonn, Germany). **Gas chromatograhic determination of nitrogen-containing pesticides using the nitrogen flame ionization detector (N-FID).** *Residue Rev.* 54: 113-182; 1975. (115 references)

More than half of the presently used pesticides contain organic nitrogen, therefore, it is possible that organic nitrogen compounds may occur in food and environment as residues from pesticide application. Nearly all of these organic nitrogen compounds can be identified and quantitatively determined by gas chromatography (GLC). The nitrogen flame ionization detector (*N*FID) has proved to be extremely appropriate, for cleanup is simplified by the selectivity of this detector and the sensitivity reaches a detection limit of picogram quantities. The construction of this detector, its operating parameters, and the detecting mechanism are described in detail. This review contains particulars and tables covering the degradation, metabolism, toxicology, analysis, and glc behavior of 161 organic nitrogen-containing compounds which may possibly occur as components of pesticide residues, among them 94 fungicides, herbicides, insecticides, acaricides, or nematicides and 67 of their degradation products or metabolites. They include amides, thioamides, nitriles, carbamates, thiocarbamates, urea derivatives, amino compounds, nitrobenzene derivatives, and heterocyclic compounds with one, two, and three ring-nitrogen atoms in the molecule. This review shows that two-column or multicolumn instruments with different column packings, possibly with detectors of differing selectivity, are necessary for satisfactory GLC identification and evaluation. (Author abstract by permission)

75-2852. Lavy, T. L. (Dep. Agron., Univ. Nebraska, Lincoln, NB 68503). **Effects of soil pH and moisture on the direct radioassay of herbicides in soil.** *Weed Sci.* 23(1): 49-52; 1975. (12 references)

The addition of 1.5 ml water or 1.5 ml 0.1 *N* oxalic acid solution to 2 g soil samples containing ^{14}C-labeled herbicides increased the ^{14}C extraction efficiencies. The employment of a modified dioxane extracting-counting solution allowed the addition of 2 ml water without causing a liquid phase separation. Extraction of benzoic acid herbicides from soil was enhanced when 5 mg oxalic acid was added to 2 g soil or when soil was acidified to pH 4.1. (Author abstract by permission)

75-2853. Miyachi, I.; Obayashi, K.; Kawagishi, A.; Kotakemori, M. (Yasugawa Factory, Sankyo Co., Ltd., Yasu, Shiga, Japan). **[Method of determining residues of binapacryl.]** *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 72-73; 1975. (Japanese)

A method was devised for clean-up of residues of binapacryl and its metabolite, 4,6-dinitro-*sec*-butyl phenol. Florisil was found to be appropriate for column chromatography. As developing solvents, mixtures of *n*-hexane and acetone at various ratios could elute binapacryl, pigments, and the metabolite in that order. For the GLC analysis, 2% silicone SE-30 on chromosorb G was found appropriate for binapacryl and 5% DEBS and 0.5% phosphoric acid on chromosorb W for the metabolite. The average percentage recovery of binapacryl with the method ranged from 91 to 97, and that of the metabolite ranged from 90 to 96 on cucumber, grape, extracted tea, soaked tea, citrus, and pear (grown in a paper bag). The detection limit of binapacryl was 0.005-0.05 ppm, and that of 4,6-dinitro-*sec*-butyl phenol was 0.02 ppm except in tea where it was 0.1-0.2 ppm.

75-2854. Terada, H.; Takase, I. (Pestic. Res. Inst., Nippon Tokushu Noyaku Seizo Co., Ltd., Hino, Tokyo, Japan). [**Microdetermination by gas chromatography, part 9. Method of determining residues of metribudyne, a triazinone herbicide.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 74-75; 1975. (Japanese)

Degradation of metribudyne, 4-amino-6 - *tert* - butyl-3 methylthio - 1,2,4 - triazin-5(4*H*)-one, gave three metabolites. These were the deamino-, diketo- (formed by oxidation of 3-thiomethyl and its desulfuration), and deamino-dethiomethyl derivatives. Residue analysis was elaborated for these metabolites. After extracting the specimen potato homogenate with acetonitrile, the extract was partitioned into chloroform, then transferred to benzene. The benzene solution was chromatographed on silica gel, then eluted with a mixture of benzene and acetonitrile (99:1) to isolate metribudyne, and with a 90:10 mixture to isolate the mixture of three metabolites. To accurately isolate and determine the original herbicide and three metabolites respectively, GLC-ECD with 5% Reoplex was utilized after separating four components on a silica gel column. The detection limit was 0.005 ppm for metribudyne, 0.01 ppm for the diketo- metabolite and deamino- metabolite, and 0.02 ppm for the deamino and dethiomethyl metabolite, with recoveries of respectively 96.5, 80.1, 87.4 and 104.8%. Recovery from soil was, in general, 85.8 - 111.5%.

75-2855. Ichikawa, T.; Hara, M.; Yoshimoto, M.; Iwane, Y. (General Institute, Chugai Seiyaku Co., Ltd., Tokyo, Japan). [**Residue analysis of a herbicide, 3'-chloro-2-methyl-*p*-valerotoluidide, Solan.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 76-77; 1975. (Japanese)

The specimen was extracted, and after transferring the extract into dichloroethane and cleaning up by Florisil column chromatography, the purified extract was hydrolyzed with concentrated hydrochloric acid. After neutralization with sodium hydroxide, the hydrolyzate was chloroacetylated with monochloroacetic acid and determined by ECD-gas chromatography. The detection limit was 0.008 ppm and the recovery was respectively 98.5, 84.3, and 83.3% from soil, tomato, and *Dioscorea batatas* spiked with 0.5 ppm of the original herbicide. The material of the column was 1% XF 1105 on chromosorb W (60-80 mesh) with a length of 1.5 m.

75-2856. Seguchi, K.; Sekiguchi, M.; Inada, S.; Asaka, S. (Ageo Res. Lab., Nippon Kayaku Co. Ltd., Ageo, Saitama, Japan). [**Residue analysis of 4-chloro-3-propylsulfinylphenyl 4'-nitrophenylether on/in citrus fruits.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 78-79; 1975. (Japanese)

Various possible metabolites of an acaricide, 4-Cl-3-Pr-sulfinyl-Ph-4'-nitro-Ph-ether (I) on/in citrus fruits include its 4-amino derivative (V), 4-Cl-3-Ph-thio-Ph -4'-amino-Ph-ethyl (VI), 4-Cl-3-Pr-sulfoxide -Ph-4'-nitrophenyl ether (IV), its 4'amino derivative (VII), 4-Cl-3-PrS Ph 4'-nitro-Ph ether (II), and 4-ClPh-4'-NO_2Ph-ether (III). Two methods of analysis were devised, one for citrus peel and one for pulp. Peels were extracted with methanol, and after two-fold liquid-liquid partitioning the amino derivatives were trifluoroacetylated and separated on a silica gel column into two groups, one comprising derivatives II, III, and VI, and the other comprising compounds I, IV, V, VII. Pulp was reduced with acetyl chloride to convert the sulfoxide into sulfide, then fractionated on a silica gel column into I/V, and IV/VII. They were then determined by GLC. Throughout the procedures, the respective recoveries were 87.0, 89.0, 77.5, 84.2, 81.8, 76.5, and 80.8% for I, II, III, IV, V, VI, and VII. The limit of detection was between 0.001 and 0.003 ppm. The method of analyzing the pulp was also described.

75-2857. Yamaoka, T.; Saito, T.; Tsujino, Y.; Nakamura, T. (Pestic. Res. Lab., Sankyo Co., Ltd., Tokyo, Japan). [**Method of determining echlomezole residues in crops and soil and its persistence.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 82-83; 1975. (Japanese)

Residues of a low toxicity soil fungicide, echlomezole (5-EtO-3-trichloro Me-1,2,4-thiadiazole), were determined by a newly devised method. In crops, the homogenized specimen was extracted with acetone. After transfer to hexane, the residue was cleaned up on a silica gel column. The residue was determined by ECD-GC or FPD-GC with partitioning or absorption chromatography if necessary. Soil specimens were extracted with acetone using a Soxhlet apparatus, and after transferring to hexane, the residue was determined by ECD-GC. When SE-30 and DEGS were used for the column, the minimum detectable amount was 2 ng on FPD-GC and 5 ng on ECD-GC. When the major metabolite of echlomezole, 3-carboxy-5 EtO-1,2,4-thiadiazole, was studied, the recovery was 81-98% after addition to crops at 0.06-1 ppm, and 90.5% (average) after addition to soil at 0.1 ppm. When echlomezole was actually applied on soil, the level in crops grown there was equal to or below the detection limit. The half-life in soil was about 15 days in a model experiment

and the level of major metabolite was below the detection limit.

75-2858. Oyama, A.; Ogyu, O.; Hagi, I. (Central Institute, Ishihara Sangyo Co., Ltd., Yokkaichi, Mie, Japan). [**Several problems and their countermeasures in residue analysis.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 86-87; 1975. (Japanese)

Several problems encountered in gas chromatographic analysis of residues are enumerated and countermeasures described. The interference of elemental sulfur in organosulfur fungicides was successfully counteracted by the use of methanol in charging the specimen onto the gas chromatograph. The peak produced by the contaminant dibutyl phthalate was somewhat reduced by using DEGS for the ECD-GLC column. In liquid-liquid partitioning of carboxylic acid type pesticides such as MCPA and 2,4-D the interfering acid material can be removed by washing the *n*-hexane layer with hydrochloric acid; the herbicidal carboxylic acid is transferred into the aqueous layer. The transfer of an aromatic amine such as 3,4-dichloroaniline into aqueous hydrochloric acid during partitioning was increased by addition of the acetonitrile to the hydrochloric acid beforehand.

75-2859. Sato, K.; Kobayashi, Y.; Matano, O.; Goto, S. (Institute of Environmental Toxicology, Kodaira, Tokyo, Japan). [**Simultaneous qualitative and quantitative analysis of organochlorine pesticides by mass chromatography. Part 2. Determination of dieldrin and its metabolites in rat urine.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 92-93; 1975. (Japanese)

Adult, SD strain rats were fed diet containing 50 or 200 ppm dieldrin for 4 weeks. The major dieldrin metabolite, pentachloroketone (PCK, Klein's metabolite), was determined in urine. Because of the non-availability of the authentic substance, the total numbers of ions of dieldrin and PCK were determined by GC/MS-CPU and the amount of each compound extrapolated. After eliminating protein with acetone, urine was extracted with ethyl acetate, and after washing with water, then condensing, the condensate was injected into GC/MS. The amount of PCK detected in the urine was 4-5 times that of the dieldrin found.

75-2860. Shoyama, M.; Miyaji, Y.; Sakakibara, J. (Aichi Pref. Police Department Crim. Sci. Lab., Nagoya, Aichi, Japan). [**Colorimetric determination of sulfur-containing organophosphorus insecticides.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 97-98; 1975. (Japanese)

The yellow pigment obtained by reacting sulfur-containing organophosphorus compounds with a solution of palladium chloride in hydrochloric acid could be extracted with organic solvents such as chloroform. Upon addition of *N,N*-diethyl-*p*-nitrosoaniline it developed a stable red color, utilizable for colorimetric determination of the original compounds. The results obtained by applying the above finding to fencapton, *O,O*-diethyl - *S* - (2-chloro -1- phthalimidoethyl) phosphorodithioate, and 3-diethoxyphosphoryl thiomethyl - *t* - chlorobenzoxazolone were described. Although the reaction mechanism has not been elucidated, the three insecticides showed the same absorption maximum at 521 nm and all the end reactants showed maximum absorption at 528 nm. The respective coefficients of variation in determination of the three insecticides by this method were 1.3, 3.3, and 4.0%. The detailed conditions of analysis were studied.

75-2861. Hattori, T.; Shimada, T.; Shioyama, I. (Chemical Laboratory, Nippon Noyaku Co., Ltd., Osaka, Japan). [**Method of analysis of isothioprolane formulations, and stability of the formulations.**] *Noyaku Kagaku (J. Pestic. Sci.)* 3(2): 99-100; 1975. (Japanese)

Isothioprolane insecticide, diisopropyl -1,3-dithiolane- 2- ylidene malonate, could be extracted from any formulations by acetone. For determination, GLC-FID with silicone SE-30 5% SW DMCS on Chromosorb W (60-80 mesh) was utilized as the column at 190°C with dibutyl phthalate as an internal standard. The stability of the active ingredient in the formulation was not affected by common carriers such as calcium carbonate, talc, and clay, or by organic solvents and emulsifiers used for making EC formulations.

75-2862. Hoshino, K.; Kato, R.; Sato, N.; Sakai, K. (Miyagi Prefect. Inst. Hyg., Sendai, Miyagi, Japan). [**Studies on gas chromatography of *N*-methyl carbamate insecticides with alkali hydrolysates.**] *Shokuhin Eiseigaku Zasshi (J. Food Hyg. Soc. Jpn.)* 16(4): 275-281; 1975. (11 references) (Japanese)

Six *N*-methyl carbamates (4-diallylamino-3,5- dimethylphenyl; 2-*sec*-butylphenyl; 3-methylphenyl; 1-naphthyl; 2-ispropoxyphenyl; and 3,5-dimethylphenyl) were hydrolyzed by sodium hydroxide, and after converting the phenols thereby obtained to their monochloroacetyl derivatives, the simultaneous determination of the derivatives by ECD-GC was studied. The monochloroacetyl derivatives could be separated well on either a column with 5% OV-17 and 5% DEGS plus 1% phosphoric acid or Florisil. The carbamates were rapidly hydrolyzed with 1 ml of 0.2 *N* sodium hydroxide in methanol; BHC isomers and DDT derivatives which were simultaneously present were almost completely decomposed in 20 min. The most appropriate condition for monochloroacetylation was reaction for 30 sec. with 10 ml each of 0.25 *N* sodium hydroxide and 2% monochloroacetic acid in benzene. The calibration curve was linear and passed through the origin. In addition, the reproducibility of monoacetylation was satisfactory, with a variation coefficient of less than 5% except in the case of 3-methylphenol. The recovery of added authentic carbamates ranged from 75 to 100%, with a detection limit of 0.007 ng of 2-*sec*-butylphenyl- and 0.095 ng of 4-diallylamino -3,5- dimethylphenyl *N*-methylcarbamate.

75-2863. Wagner, R.; Hoyer, J. (Arbeitshygienische Untersuchungsstelle, 1211 Manschnow, DDR). **Zur Methodik der Ermittlung von Arbeitsplatzkonzentrationen und zur arbeitshygienischen Situation waehrend und nach dem Heissvernebeln von PSM im Gewaechshaus.** [Method of determining work place concentrations and occupational hygiene conditions during thermal fogging atomization of pesticides in the greenhouse.] *Z. Gesamte Hyg. Ihre Grenzgeb.* 21(1): 18-20; 1975. (7 references) (German)

Dimethoate, DDVP (dichlorvos), dicofol, and methyl parathion concentrations were measured in greenhouses during and after application of these pesticides in the form of a thermal fog. Dimethoate, dicofol, and methyl parathion were adsorbed on an FPP-15 type double filter, and distilled water was used for the absorption of DDVP for subsequent extraction and thin-layer chromatographic and photometric determination. The concentrations measured during application substantially exceeded the respective MAC values. The concentrations measured were 5.5 mg/m³ for dicofol, 8.7 mg/m³ for dimethoate, 0.95 mg/m³ for methylparathion, 15.8 mg/m³ for DDVP. The concentrations dropped to 10% to 1% of the respective MAC values after 3 hr, including total ventilation during the last hour.

75-2864. Pfeilsticker, K.; Fabricius, G.; Timme, G. (Dep. Food Science, Univ. Bonn, Bonn, Germany). **Simultane, gas-chromatographische Bestimmung von Aethylenoxid, Aethylenchlorhydrin und Aethylenglykol in Getreide.** [Simultaneous, gas-chromatographic determination of ethylene oxide, ethylene chlorohydrin, and ethylene glycol in grain.] *Z. Lebensm.-Forsch.* 158(1): 21-25; 1975. (13 references) (German)

A method is described for the simultaneous gas-chromatographic determination of ethylene oxide, ethylene chlorohydrin, and ethylene glycol in grains. Following extraction with methanol from non-comminuted grains at 25°C for 24 hr in a shaking machine, the liquid phase is separated by centrifugal filtration, and is directly injected into the gas chromatograph with flame ionization detector. The starting temperature is adjusted by cooling with carbon dioxide, and the temperature is then increased to 180°C. The yields were determined to be 73% for ethylene oxide (concentration range 25 ppm), 93% for ethylene chlorohydrin (concentration range 50 ppm), and 99% for ethylene glycol (concentration range 50 ppm). The standard deviations are ±1.70 ppm for ethylene oxide, ±1.15 ppm for ethylene chlorohydrin, and ±0.62 ppm for ethylene glycol. The lower limits of detection are 1.7 ppm (0.035 μg) for ethylene oxide and 2.5 ppm (0.05 μg) for ethylene chlorohydrin and ethylene glycol.

75-2865. Sherma, J. (Dep. Chem., Lafayette Coll., Easton, PA). **Thin-layer chromatography: recent advances.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 3-87. (321 references)

Many advances have been made in the area of thin-layer chromatography for the analysis of pesticides over the past five years. The latest procedures developed for and applied to the analysis of multiresidues of various classes of pesticides and individual residues of specific compounds are described. Sample preparation, chromatographic systems, detection, identification, and quantitative analyses are described for chlorinated insecticides, chlorinated herbicides, organophosphate insecticides, carbamate pesticides and related compounds, triazine herbicides, dinitrophenol pesticides, uracil herbicides, pyrethrins, and methylenedioxyphenyl compounds. Detailed experiments concerning a semiquantitative screening method for organochlorine residues in fats and vegetables; determination of carbaryl residues in apples and spinach; and determination of triazine herbicides in soil and water are given.

75-2866. Horgan, D. F., Jr. (Water Assoc. Inc., Framingham, MA). **High speed liquid chromatography.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 89-115. (11 references)

Although liquid chromatography cannot replace gas chromatography in certain phases of pesticide residue analysis, it does have certain advantages. The analysis of heat-labile or poorly volatile materials is possible by liquid chromatography without the need for forming derivatives. Also, in most cases, there is no need for sample cleanup. The greatest disadvantage of liquid chromatography is that the detector sensitivity cannot yet equal that of gas chromatography. The theory and principles of liquid chromatography are discussed. Detectors such as refractive index and ultraviolet photometers are described. Chromatographic columns are considered in relation to tubing, supports, and stationary phases. Specific applications of liquid chromatography in the areas of spinach and fresh water fish contamination by pesticides are described.

75-2867. Pararela, N. R.; Orloski, E. J. (Am. Cyanamid, Princeton, NJ). **Abate insecticide.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 119-146. (20 references)

Abate (temophos), a non-systemic organophosphate, is highly effective against the larvae of mosquitoes and chironomids. The compound has good insecticidal activity and good residual properties when applied to foliage. There appear to be no significant adverse effects against beneficial insects. Abate is one of the least toxic organophosphate insecticides. For formulation analysis

the active ingredient is extracted from solid samples with methylene chloride, the solvent evaporated and the residue dissolved in a mixture of ethylacetate and hexane. Liquid samples are directly dissolved in the ethylacetate-hexane mixture. After removing interfering contaminants by liquid-solid chromatography on silica gel, the solvent is removed and the residue dissolved in methanol. The absorbance of the methanol solution at 274 nm is then determined. The insecticide content is determined by comparison with an insecticide standard which has been carried through the chromatography step. In metabolic studies on bean leaves, there was little, if any, migration of abate from the site of application. The primary route of elimination in the rat was in the feces and urine. Both studies showed only small amounts of metabolites formed with the sulfoxide most prominent. Specific examples for sample preparation and handling are given for moist crops, dry hay, peanut shells, cured tobacco, oil crops, citrus products, bovine muscle and kidney or liver tissues, bovine fat tissue, milk, sediment and soil, water, and marine animals. The control peaks for all tissues tested were low enough to permit measurements at the 0.05 ppm level for both abate and abate sulfoxide using the recommended method.

75-2868. Romine, R. R. (Union Carbide Corp., Res. Div., South Charleston, WV). **Aldicarb.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 147-162. (9 references)

Aldicarb is a broad-spectrum, rapidly absorbed, soil applied systemic pesticide which controls insects, mites, and nematodes. Pest control begins about 24 hr after application and lasts about 10 weeks. Aldicarb acts as a cholinesterase inhibitor. Its effects are reversible and are not cumulative. Aldicarb is available commercially only in a granular product containing 10% aldicarb impregnated on organic granules with small quantities of a binding agent. For formulation analysis the pesticide is extracted from the granules by Soxhlet extractor using methylene chloride solvent. The extract is diluted to a known volume with additional solvent and an aliquot analyzed for aldicarb content by IR spectroscopy utilizing the carbamate carbonyl absorbance at 5.75 μm. The absorbance of the sample at 5.75 μm is measured, and the aldicarb content is determined by comparison with the absorbance of a standard solution. For residue analysis in agricultural crops and environmental substrates both a colorimetric and a gas chromatographic method have been successfully employed. For gas chromatography, the toxic residue of aldicarb is composed of aldicarb and its sulfoxide and sulfone metabolites, all 3 of which are determined as a total residue by first oxidizing aldicarb and aldicarb sulfoxide to aldicarb sulfone with peracetic acid and then determining total aldicarb sulfone by gas chromatography. The aldicarb sulfone is determined utilizing a flame-photometric detector incorporating a 394 nm filter specific for sulfur-containing compounds, and it is quantitated by reference of the peak height to a previously prepared calibration curve. Components of the toxic residue may be separated by Florisil liquid-column chromatography prior to oxidation to the sulfone and the components separately quantitated by procedures similar to those used for the total residues. For the colorimetric method the determination of total aldicarb residue is based on the carbamoyloxime group of the molecule. The carbamoyloxime is hydrolyzed with base to 2-methyl-2-(methylthio)propionaldehyde oxime. Hydrolysis of the oxime in acidic medium forms the aldehyde, 2-methyl-2-methylthiopropionaldehyde and hydroxylamine. The hydroxylamine is oxidized with iodine to nitrous acid, which is determined colorimetrically by a modification of the Griess test for nitrite.

75-2869. Anderson, C. A. (Chem. Res., CHEMAGRO Div., Baychem Corp., Kansas City, MO). **Baygon.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 163-178. (8 references)

Baygon (propoxur) is particularly effective against cockroaches, flies, mosquitoes, and other insects which directly affect man and animals. It has rapid knockdown and residual properties. Aphids, lygus bugs, grasshoppers, and other crop insects have been successfully controlled by foliage sprays. Root maggots and root worms on many crops have been controlled by soil applications. Systemic action has been demonstrated on thrips, aphids, leaf miners, leafhoppers, and scales. The acute oral LD50 for male rats and guinea pigs are 95 and 40 mg/kg, respectively. The dermal LD50 for the same species is 1000 mg/kg. Inhalation LD50 is 1440 μg/l. For formulation analysis, the active ingredient in the technical material and formulations is determined by measuring the IR absorbance of the carbonyl peak at 1750/cm. For residue analysis, baygon and its metabolites are extracted from plant or animal tissue and separated into individual fractions. Baygon is hydrolyzed to the isopropoxyphenyl compound, and a trichloroacetyl derivative is prepared. The metabolites are hydrolyzed by β-glucosidase for plant samples, or dilute acid for animal samples, to give the corresponding aglycones. A trichloroacetyl derivative of one of the aglycones, *o*-isopropoxyphenyl *N*-hydroxymethylcarbamate, is converted directly to a trichloroacetyl derivative. All derivatives are determined by electron-capture GC. Specific examples of the recovery of baygon or its metabolites from moist crops, dry crops, grain, oil crops, animal tissue, and milk are given.

75-2870. Tucker, B. (Chevron Chem. Co., Ortho Div., Richmond, CA). **Bux insecticide.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G.

Zweig, Eds., Academic Press, New York, 1973, p. 179-185. (1 reference)

Bux (metalkamate) insecticide, used to control corn rootworm larvae, has an acute oral LD50 to rats of 87 mg/kg and a dermal LD50 for rabbits of 400 mg/kg. It is formulated in clay granules containing 10% (w/w) Bux insecticides. For residue analysis it is extracted from crop or soil with methylene chloride. Oily crop samples are partitioned between hexane and acetonitrile before column cleanup on a column containing a layer of Nuchar-attaclay and a layer of silicic acid. Bux insecticide is eluted with ethyl acetate and determined by GC using a microcoulometric hydrogen cell or by TLC. The limit of detection for both the GC and TLC methods is 0.02 ppm. These procedures have been used to analyze corn plant, corn ears, rice straw, rice grain, soil, and water with recoveries of about 80%.

75-2871. Cook, R. R. (Niagara Chem. Div., FMC Corp., Middleport, NY). **Carbofuran.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 187-210. (14 references)

Carbofuran, a broad-spectrum insecticide-nematicide, has been used to control corn rootworm on field corn, rice water weevil and mosquitoes on rice, nematodes and wire worms on sugarcane, alfalfa weevil on alfalfa, and thrips and nematodes on peanuts. A methylcarbamate, it is a readily reversible cholinesterase inhibitor effective through oral ingestion or inhalation. Acute oral LD50 to albino rats is 8.2-14.1 mg/kg; to dogs, 19 mg/kg; and to chickens, 25-39 mg/kg. For formulation analysis, intact carbofuran is determined by GC using an internal standard and comparing the peak area of the unknown sample to the peak area of a standard. For residue analysis, a gas chromatographic procedure which determines the intact carbamate residues of carbofuran is recommended. A mild acid hydrolysis frees the conjugated carbamate forms and allows an organic solvent extraction. Liquid-solid adsorption column chromatography provides an adequate sample cleanup. Oily crops require a liquid-liquid partition cleanup step in addition to the column cleanup. Determination of the residues is by GC equipped with a nitrogen-specific microcoulometric detector.

75-2872. Voss, G.; Kossmann, K.; Geissbuehler, H. (CIBA-GEIGY, Ltd., Basel, Switzerland). **Chlordimeform.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analysis of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 211-230. (13 references)

Chlordimeform, a broad spectrum acaricide and insecticide, is effective against mites resistant to organophosphorus insecticides and kills eggs, larvae, and adults by both contact and vapor action. The acute oral LD50 to female and male rats is in the range of 170 to 355 mg/kg. Acute dermal toxicity to rats is 640 mg/kg for chlordimeform base and about 4000 mg/kg for the hydrochloride salt. For formulation analysis the active ingredient in the technical material of chlordimeform free base of its formulations is determined by potentiometric titration with hydrochloric acid. For residue analysis by a colorimetric procedure chlordimeform and its metabolites are hydrolyzed to 4-chloro-*o*-toluidine, which is steam distilled and extracted into isoctane by a distillation-extraction head. Diazotization of 4-chloro-*o*-toluidine and coupling with *N*-ethyl-1-naphthylamine yields a stable purple dye which is determined colorimetrically. Before colorimetric measurement, interfering azo dyes derived from plant or soil constitutents are removed by chromatography on a cellulose column. The colorimetric method is sensitive to 0.05 ppm as calculated for a 50-gm sample. For residue analysis by gas chromatography, chlordimeform and its metabolites are hydrolyzed to 4-chloro-*o*-toluidine by successive treatments with acetic acid and sodium hydroxide. The hydrolysis product is steam distilled and extracted into isooctane. The diazo moiety of the diazotized aromatic amine, unlike the colorimetric procedure, is exchanged for iodine by potassium iodide treatment, using iodine as a catalyst. The iodinated derivative is measured by electron-capture GC. This method will detect 10 pg of pure standard or at least 0.05 ppm in terms of the original pesticide in crops, animal products, and soils. Examples of recovery of total chlordimeform residues by the gas chromatographic method are given for apples, peaches, pears, plums, chicken meat, eggs, beef, beef liver, beef fat, and cow's milk.

75-2873. Pasarela, N. R.; Orloski, E. J. (Am. Cyanamid, Princeton, NJ). **Cyolane systemic insecticide (I) and Cytrolane systemic insecticide (II).** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 231-251. (4 references)

Cyolane (2-(diethoxyphosphinylimino)-1,3-dithiolane) and Cytrolane (2-(diethoxyphosphinylimino)-4-methyl-1,3-dithiolane) are available as emulsifiable concentrates and granular formulations. For formulation analyses by an ultraviolet procedure, methylene chloride solutions containing Cyolane or Cytrolane are passed through silica gel which absorbs the compound and removes interfering substances. The insecticide is desorbed with methanol and the solution is measured in the ultraviolet region at 290 and 250 nm. The concentration of the insecticide is calculated by a modified baseline technique versus a standard solution carried through the same procedure. Formulation analysis by means of a gas-liquid chromatographic procedure calls for dilution of liquid samples or methanol extracts to approp-

riate volume with methanol and the insecticide content determined by a gas-liquid chromatographic procedure employing an internal standard technique. For residue analysis, residues of Cyolane and Cytrolane are extracted from the prepared sample with chloroform, purified by a combination of clean-up steps appropriate to the particular type of sample being analyzed, and measured by GLC with an instrument equipped with a selective phosphorus-sensitive detector. Recovery data of Cyolane and Cytrolane from plant tissues is given for bean pods, beans, peas, lucerne, tomatoes, green wheat, tobacco, wheat, rice, cottonseeds, and hops.

75-2874. Anderson, C. A. (Chem. Res., CHEMAGRO Div., Baychem Corp., Kansas City, MO). **Dasanit.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 253-269. (11 references)

Dasanit, having both insecticidal and nematicidal activity, may be applied to the soil by broadcast, band, and in-furrow treatments to give protection against parasitic, sedentary, and free-living nematodes. The acute oral LD50 for male and female rats are 10.5 and 2.2 mg/kg, respectively; corresponding dermal LD50s are 30.0 and 3.5 mg/kg, when dissolved in xylene and placed on shaved backs of animals. Acute inhalation LD50 for male rats is 11.3 μg/l. No mutagenic or teratogenic effects have been noted. There are 2 major methods for the determination of Dasanit in technical material and formulations. The titrimetric procedure employs the reducing potential of the titanous ion to convert the sulfoxide group in Dasanit to the sulfide. The other method is particularly efficient for manufacturing control analyses as it is automated. In this second method Dasanit is oxidized with bromine, extracted with aqueous acetic acid, digested with perchloric-sulfuric acid, and the phosphorus content determined colorimetrically as a vanadophosphomolybdate complex. For residue analyses, gas-liquid chromatography is preferred because it is more sensitive and specific than other methods. The sample is extracted with a combination solvent of acetone and chloroform. The extract is partitioned with a nonpolar solvent to remove fatty materials. The remaining residue is oxidized with *m*-chloroperbenzoic acid, and the final oxidation product is injected into a gas chromatograph. Recovery data of Dasanit, the oxygen analog, and the oxygen analog sulfone from plant material is given for corn kernal, peanut meal, and tobacco.

75-2875. Barney, J. E.; Ja, W. Y.; O'Connor, M. S. (Stauffer Chem. Co., Richmond, CA). **Dyfonate.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 269-277. (2 references)

Dyfonate is available in various granular formulations containing 2, 5, 10, 12, 15, and 20% fonofos by weight and as an emulsifiable concentrate containing 4 lb Dyfonate/gallon. It can be determined for formulation analysis by gas chromatography using aldrin as internal standard. Liquid emulsifiable concentrations are diluted to an appropriate concentration with carbon disulfide, while granular formulations are first extracted with a solvent or mixture of solvents known to give complete Dyfonate extraction. Residue analysis calls for the extraction of crop and soil samples by blending a representative sample with benzene. A general liquid-solid chromatographic cleanup on silicic acid, preceded by an oil removal partition as required for crops such as peanuts and corn ears, is used when necessary. Dyfonate is determined by GC with detection by an alkali flame ionization detector with a rubidium sulfate tip. Residues of 0.05 and 0.03 ppm for Dyfonate and the oxygen analog can be detected for all types of crops. Recovery data of Dyfonate and the oxygen analog are given for bean plants, broccoli, brussels sprouts, cabbage, carrots, cauliflower, corn ears, corn plants, green beans, lima beans, mint, peanuts, potatoes, strawberries, sweet potatoes, sugar cane, tobacco, tomatoes, turnips, and watermelon.

75-2876. Jenny, N. A.; Kossmann, K. (NOR-AM, Agric. Products, Inc., Woodstock, IL). **Formetanate.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 279-296. (6 references)

Formetanate hydrochloride, an acaricide-insecticide, is effective in controlling spider mites, rust mites, certain aphids, thrips, lygus bugs, leaf hoppers, slugs, and snails on horticultural, agronomic, and ornamental plants. It is especially effective against organophosphate resistant mites. The acute oral toxicity (LD50) of formetanate hydrochloride to rats is about 21 mg/kg. Acute dermal LD50 to rats and rabbits is greater than 5.6 and 10.2 gm/kg, respectively. Formetanate hydrochloride is available as a 92% water soluble powder and 58% and 23% water soluble products. For formulation analyses, a base titration procedure is recommended. Residue analysis by a colorimetric method is based on hydrolysis of formetanate hydrochloride with acetic acid followed by sodium hydroxide to give *m*-aminophenol which is diazotized and coupled with *N*-1-naphthylethylenediamine dihydrochloride to give a reddish-purple colored azo dye of maximum absorbance 555 nm. A gas-liquid chromatographic procedure for residue analysis is also based on hydrolysis of formetanate hydrochloride with acetic acid followed by sodium hydroxide to give *m*-aminophenol. The *m*-aminophenol is brominated to give 2,4,6-tribromo-3-aminophenol which is measured using a gas chromatograph equipped with an electron-capture detector and gives a linear response in concentrations up to 12.5 μg/ml, about 2 ppm formetanate

hydrochloride. Recovery data of formetanate hydrochloride by the gas chromatographic method is given for alfalfa, apples, citrus fruit peel, citrus pulp, grapes, pears, and raisins.

75-2877. Shell Development Co. (Anal. Dep., Biol. Sci. Res. Cent., Modesto, CA). **Gardona insecticide.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 297-316. (1 reference)

Gardona (chlorfenvinphos) has an acute oral LD50 for rats of 4000 to 5000 mg/kg and an acute dermal LD50 for rabbits of greater than 5000 mg/kg. It has shown very good results against corn earworms, fall armyworms, gypsy moths, and houseflies. It is formulated as a 75% wettable powder, 2 lb/gal emulsible concentrate, 4 lb/gal solution, and low-concentration dusts. For formulation analysis, Gardona insecticide is readily chromatographed by dilution or extraction with methylene chloride to provide a solution suitable for chromatographic analysis. Quantitation for Gardona is achieved by comparison with the peak height or area obtained for the sample with a similar measurement for a standard solution of Gardona, 2-chloro-1-(2,4,5-trichlorophenyl)vinyl dimethyl phosphate. An alternative method for formulation analysis is provided by infrared absorption. Residues of Gardona can be determined by cholinesterase inhibition, gas-liquid chromatography/electron-capture detection, and GLC phosphorus detection.

75-2878. Calderbank, A. (Plant Protect., Ltd., Bracknell, Berkshire, England). **Menazon.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 317-329. (8 references)

Menazon is used to control aphids on a wide variety of fruit and vegetable crops, either by soil or seed treatment or by foliar application. It is harmless to most other insect species and aphid predators. The acute oral LD50 to female rats is 1950 mg/kg; dermal LD50 is greater than 200 mg/kg. Menazon is marketed as "Saphicol," which is a stable nonaqueous suspension containing 40% menazon. The recommended method for formulation analysis calls for extraction from the sample by aqueous dioxane and passing an aliquot of the extract through a cation-exchange resin column which retains the menazon. Menazon is eluted with methanolic ammonium acetate solution and wet oxidized to orthophosphoric acid. The phosphorus content is determined as the phosphovanadomolybdate complex by differential spectrophotometry at 430 nm. For residue analysis menazon is extracted from food crops with methanol and separated from naturally occurring phosphorus-containing compounds as a cation-exchange resin column. The menazon is eluted from the resin using buffer solution and further purified by extraction into chloroform. The chloroform is evaporated and the residual menazon wet oxidized to inorganic phosphate and determined as the deep blue molybdophosphate complex at 820 nm. Recovery of added menazon from 50 gm samples of food crops are listed for brussels sprouts, potatotes, sugar beets, sugar beet foliage, apples, broad beans, cabbage, and strawberries. The detection limits were about 0.05 ppm on a 50 gm sample. The detection methods have been successful on other crops such as lettuce, black currants, gooseberries, carrots, Kaffier corn, tobacco, and soil.

75-2879. Leitch, R. E.; Pease, H. L. (E. I. du Pont de Nemours and Co., Wilmington, DE). **Lannate—methomyl.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 331-338. (2 references)

Lannate, toxic to insects both by direct contact and ingestion, is particularly useful in commercial plants of sweet corn, tomatoes, potatoes, cabbage, cauliflower, broccoli, head lettuce, and tobacco. The acute oral toxicity LD50 for the male rat is 17 mg/kg; female rat, 24 mg/kg. Lannate-methomyl insecticide is commercially available in the United States as a water-soluble powder containing 90% active ingredient. The insecticide is also prepared, for foreign markets, as a 45% soluble powder and a 25% wettable powder for application in water sprays. For formulation analysis the sample is diluted with tetrahydrofuran and analyzed by liquid chromatography, using an ultraviolet absorption detector. Electronic integration is used to measure peak area. Acetanilide is used as an internal standard. For residue analysis methomyl residues are determined by the gas chromatographic measurement of the volatile, more stable hydroxamate, methyl-*N*-hydroxythioacetimidate. Methomyl is extracted from the substrate by an organic solvent and subsequent alkaline hydrolysis yields the hydroxamate. Intermediate solvent-partitioning cleanup steps are needed to minimize possible interfering compounds.

75-2880. Leary, J. B. (Chevron Chem. Co., Richmond, CA). **Monitor.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 339-344.

Monitor, an organophsophorus compound of broad spectrum activity as a contact and residual insecticide-acaricide, is active against several species of aphids, worms, scales, and mites on various trees, fruits, and vegetable crops. Acute oral LD50 to rats is 20 mg/kg. Acute dermal LD50 to male rabbits is 118 mg/kg. A gas chromatographic method of formulation analysis calls for extracting the sample or diluting it with acetone and analyzing by means of a thermal conductivity detector. A

second, but not recommended, method utilizes liquid-column chromatographic cleanup followed by hydrolysis using sodium hydroxide and back-titration of the excess sodium hydroxide with hydrochloric acid. Two methods have been developed for residue analysis. One, a gas chromatographic method, is both sensitive and specific. The other, a thin-layer chromatographic method, lacks sensitivity but is specific and useful for confirmatory purposes. The recommended method calls for extracting Monitor residue with ethyl acetate and removing interfering substances by cleanup on a silica gel column. The residue is measured by GC using a thermionic detector.

75-2881. Miyamoto, J. (Res. Dep. Pestic. Div., Sumitomo Chem. Co., Ltd., Osaka, Japan). **Neo-Pynamin.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and Analyses of Pesticides of International Importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 345-353. (2 references)

Neo-Pynamin, an ester of chrysanthemic acid, acts on houseflies, mosquitoes, and cockroaches and is also effective against *Lepidoptera*, aphids, leaf-hoppers, and plant-hoppers on various crops. Oral LD50 to rats is more than 5 gm/kg; to mice, 1,300 mg/kg. Neo-Pynamin is marketed in the form of 0.1% oil formulation, 25% emulsifiable concentrate, 0.5% dust, and as the active ingredient in aerosol formulations admixed with other pyrethroidal compounds and synergists such as piperonyl butoxide. The active ingredient in the technical material and in formulations is determined by measurement of the UV absorption at 282 nm. Impurities are removed by thin-layer chromatography. In gas-liquid chromatographic procedures Neo-Pynamin is separated by gas chromatography and measured by flame ionization detection by use of internal standard.

75-2882. Stone, G. M. (Uniroyal Chem., Division of Uniroyal, Inc., Naugatuck, CT). **Omite.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 355-361. (1 reference)

Omite, a specific acaricide, is effective for controlling several species of mites on a variety of food crops and ornamental plants. Acute oral LD50 for albino rats is 2200 mg/kg. Acute dermal LD50 of Omite 30% wettable powder for albino rabbits is greater than 10,000 mg/kg. Omite is a severe eye irritant. Wearing of goggles is recommended. It is marketed in the form of a 30% wettable powder, a 4% dust, and a 6-lb Omite/gallon emulsifiable concentrate. For formulation analysis, Omite is assayed by IR spectroscopy based on measurements of the propargyl absorption at 3.03 *m*m in comparison with a known Omite standard. For residue analysis Omite is extracted from macerated crops and, after cleanup, is determined by gas-liquid chromatography employing a flame photometric detector with sulfur filter (394nm). Recovery data from fortified samples is given for apples, plums, peaches, oranges, grapefruit, strawberries, potatoes, corn, cotton, almonds, walnuts, and hops.

75-2883. Leary, J. B. (Chevron Chem. Co., Richmond, CA). **Orthene.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York 1973, p. 363-369. (1 reference)

Orthene, an organophosphorus compound with residual systematic activity, is effective against aphids, several species of armyworms, bagworms, cabbage looper, diamondback moth, imported cabbageworm, bollworm, lace bugs, leaf miners, lygus bugs, leafhoppers, cutworms, thrips, and *Diabrotica*. Acute oral LD50 of technical Orthene to rats is 945 mg/kg for males and 866 mg/kg for females. Acute oral LD50 for mice is 361 mg/kg. For formulation analysis the sample is extracted or diluted with an internal standard solution in methylene chloride and analyzed by gas chromatography using a thermal conductivity detector. Residues of Orthene and its metabolite ORTHO 9006 are extracted with ethyl acetate and interfering substances are removed by cleanup on the silica gel column. The residue is measured by programmed temperature GC using a thermionic detector.

75-2884. Nishi, K.; Konishi, K.; Tan, N. (Chem. Res. Lab., Takeda Chem. Ind. Ltd., Osaka, Japan). **Padan.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 371-384. (8 references)

Padan, an insecticide effective against economically important crop-attacking insects, controls *Lepidopterous* larvae and *Coleopterous* insects. It effectively controls rice stem borers, common cabbage worms, cabbage armyworms, citrus leaf miners, apple leaf miners, diamondback moths, codling moths, cucurbit leaf beetles, striped cabbage flea beetles, Mexican bean beetles, and Colorado potato beetles. Acute oral LD50 to female rats is 250 mg/kg; to male rats, 192 mg/kg. Acute dermal LD50 to mice is greater than 1000 mg/kg. Padan is marketed as a 50% water soluble powder, a 2% dust, and a 4% granular. It is also combined with other insecticides and/or fungicides. For formulation analysis the active ingredient is determined by polarography. Padan is hydrolyzed with aqueous ammonia containing nickelous chloride to yield the nickel chelate of 1,3-dimercapto-2-(*N*,*N*-dimethylamino)propane, which decomposes quantitatively into 4-(*N*,*N*-dimethylamino)-1,2-dithiolane.

75-2885. Desmoras, J.; Laurent, M.; Buts, M. (Soc. Usines Chim. Rhone-Poulenc, Vitry-sur-Seine, France). **Phosalone.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 385-397. (17 references)

Phosalone is an insecticide and acaricide with a broad spectrum of activity. It is recommended for treatment of orchards, grapes, rapeseed, cotton, sugar-beet, potato, alfalfa, market garden crops, ornamental crops, tea, tobacco, and others. It is also useful against animal ectoparasites and the sheep blowfly. The acute oral LD50 for the mouse is 180 mg/kg; for the rabbit, the LD30 for percutaneous administration is 1000 mg/kg. Phosalone is formulated as wettable powders, emulsifiable concentrates, and dusts, either alone or in association with other pesticides such as methyl parathion or DDT. Ultraviolet or infrared spectrometry may be used for formulation analysis. However, the most useful methods are colorimetry and GLC. The GLC determination is carried out by the internal standard method. Separation is performed on a moderately polar silicone stationary phase with a thermal conductivity detector. Several methods have been developed for residue analysis. The recommended one involves extraction with an organic solvent, partition and column chromatographic clean-up, and GLC determination with an electron capture detector. In an alternative biological method, extraction and cleanup are carried out as for the recommended GLC method. The phosalone is determined by measuring the toxicity towards *Daphnia pulex* as susceptible organism. Thin-layer chromatography may be used for examining the solution obtained during residue analysis by the recommended GLC method. Thus it provides another means of identifying the residue.

75-2886. Bullock, D. J. W. (Plant Protect., Ltd., Bracknell, Berkshire, England). **Pirimicarb.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 399-415. (2 references)

Pirimicarb, a fast acting selective aphicide, is effective against organophosphorus-resistant strains of aphids. It possesses both a contact and fumigant action. It inhibits cholinesterase, but does not produce delayed neurotoxic effects. The aphicide is available as a 50% w/w dispersible powder containing a blue dye, as a 20% w/v aqueous solution of the *p*-toluene sulfonate, and as a 5% w/w granule. Smoke generators are also available. Formulation analysis is based on the hydrolysis of pirimicarb with boiling aqueous sodium hydroxide to yield dimethylamine. The dimethylamine is steam distilled off into 2% boric acid and determined either by titration with standard hydrochloric acid or absorptiometry at 430 nm as the yellow copper dimethyl-dithiocarbamate complex. Pirimicarb is degraded photochemically and within plants to 2 products which retain the active carbamate group, 5,6-dimethyl-2-*N*- methylformamido- dimethylcarbamate-pyridin- 4- yl and 5,6-dimethyl-2-*N*-methylamino- dimethylcarbamate-pyridin-4-yl. To perform a residue analysis on total carbamate the sample is macerated with chloroform and the extract washed successively with sodium hydroxide solution, water, and a slightly acid phosphate buffer. The chloroform is removed and the residue steam distilled with *N* sodium hydroxide, liberating dimethylamine. The dimethylamine is absorbed in 0.1 *N* hydrochloric acid and determined colorimetrically as the yellow copper dimethyl-dithiocarbamate complex. When emulsions occur which are difficult to handle, the sample is macerated with acetone. The emulsifying agents are removed by adding 0.1 *N* hydrochloric acid and filtering. The filtrate is buffered to pH 6.5 and extracted into chloroform, which is then treated as the chloroform extract mentioned above. For determining pirimicarb only, the sample is macerated with acetone and filtered, 0.1 *N* hydrochloric acid added to the filtrate, filtered again, washed with hexane buffered to pH 6.5 and extracted into chloroform. The extract is transferred quantitatively to a thin-layer plate which is developed and viewed in ultra-violet light, the pirimicarb band is removed and steam distilled with *N* sodium hydroxide to liberate dimethylamine, which is determined as mentioned above. A gas chromatographic method and a cholinesterase method are also available.

75-2887. Getzendaner, M. E.; Corbin, H. B. (Residue Res., Ag-Organics Dep., Dow Chem., Midland, MI). **Plictran miticide.** *IN: Analytical Methods for Pesticides and Plant Growth Regulators. Vol. VII, Thin-Layer and Liquid Chromatography and Analyses of Pesticides of International Importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 417-430.

Plictran miticide controls leaf-feeding mites but is relatively harmless to predacious mites. Tricyclohexyltin hydroxide, the active ingredient of Plictran, has an acute oral LD50 of 540 mg/kg for white rats, 650 mg/kg for chicks, and 500-100 mg/kg for rabbits. For formulation analysis plictran is dissolved in 2-butanone and titrated potentiometrically with a standard perchloric acid solution. Tin residues may be present in inorganic or organic form. For total tin analysis, sample oxidation and separation (by distillation or extraction as SnI_4, is followed by colorimetry using dithiol. For total organic tin residue analysis, a M HCl solution is extracted with chloroform, and the chloroform extract residue is treated as for inorganic tin. Recovery studies were performed on apples, pears, and citrus fruits.

75-2888. Eto, M.; Miyamoto, J. (Dep. Agric. Chem., Fac. Agric., Kyushu Univ., Fuknohu, Japan). **Salithion.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 431-440. (8 references)

Salithion, a wide-spectrum insecticide, successfully controls moths, aphids, mealybugs, and beetles on apples, pears, and vegetables. Acute oral LD50s for male and female rats are 125 and 180 mg/kg, respectively. Salithion is commercially sold as a 25% emulsifiable liquid formulation and as a 25% wettable powder. Salithion can be colorimetrically determined for formulation analysis. The procedure calls for a preliminary cleanup by TLC, after which Salithion is hydrolyzed with alkali to yield saligenin which reacts with 4-aminoantipyrine and potassium ferricyanide at an adjusted pH to form a red pigment. The color intensity is measured with a photometer at 505 nm. A gas-liquid chromatographic procedure, also available for formulation analysis, calls for isolation and detection with a hydrogen flame ionization detector. Benzyl benzoate or malathion is suitable as an internal standard. For residue analysis, cholinesterase-inhibiting pesticides can be determined by an enzymatic method. Salithion itself is a poor cholinesterase inhibitor, but is converted to a strong one by oxidation. Residual activity of cholinesterase after inhibition is assayed by the colorimetric determination of unchanged acetylcholine.

75-2889. Brown, B. B. (S. B. Penick and Co., New York, NY). **SBP-1382.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 441-457. (4 references)

SBP-1382 (resmethrin, (5-benzyl-3-furyl)methyl-2,2- dimethyl- 3-(2-methylpropyl)cyclopropane carboxylate) is a totally synthetic pyrethroid offering excellent control of mosquitoes, flies, beetles, mites, wasps, ants, roaches, and other crawling insects. It is particularly effective against insect species resistant to the chlorinated hydrocarbons and organophosphates. Oral LD50 in rats is about 10,000 mg/kg for the 100% *trans*-ester and 100-200 mg/kg for the all *cis*-isomer. SBP-1382 is available in several forms, as an 84.5% technical material, 25% and 40% oil concentrates, 10% dust or wettable powders, a 2-lb/gal emulsifiable concentrate for agricultural use, a 15% concentrate for aqueous pressurized sprays, and a special 10% solvent-free emulsifiable concentrate for home and garden use. The recommended method for formulation analysis employs GLC. The sample is dissolved in a high-boiling aromatic hydrocarbon and subjected to GLC analysis. The relative response of the SBP-1382 analytical standard to docosane is measured on a mixture of known concentration and the factor calculated from the peak areas and sample weights. The purity of any SBP-1382 sample is calculated using this factor and the same GLC conditions. The *trans/cis* ratio can also be calculated by GLC. A recommended colorimetric method calls for heating SBP-1382 with an acid reagent containing 4 parts orthophosphoric acid and 1 part ethyl acetate. The accuracy of this method is + 1%; when analyzing formulations the accuracy is about + 0.5%. For residue analysis on plant surfaces a determination of surface contamination is carried out by extraction with hexane, concentration and filtration of the extract, chromatography of the filtrate on a dual bed column of AluminAR and Florisil, and analysis by either TLC or GLC. The recommended method for determining residues in water arising from spray drift is carried out by extraction of the water with hexane, drying and concentration, followed by either the TLC or GLC analysis. The recommended method of residue analysis for milled grain involves extraction with hexane, partitioning the residue between hexane and acetonitrile, chromatography of the acetonitrile residue on a column of AluminAR, and final assay by either TLC or GLC.

75-2890. Miyamoto, J. (Res. Dep. Pestic. Div., Sumitomo Chem. Co. Ltd., Osaka, Japan). **Sumithion.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 459-469. (5 references)

Sumithion (fenitrothion), a broad-spectrum insecticide, acts by direct contact or as a stomach poison and is used on many crops including fruits, field crops, vegetables, rice, cotton, cereals, cocoa, tea, and coffee for control of stem-borers, white flies, fruit flies, mealybugs, mirids and bugs, thrips, aphids, mites, lady beetles, caterpillars, and soft scale insects. Oral LD50 to mice is around 1300 mg/kg. Sumithion is marketed as a 70% or 50% emulsifiable concentrate, 40% water-dispersible powder, 2% and 3% dust, and 60% concentrate for low volume spray. The active ingredient in the technical material and in formulations is determined by measuring absorption at 400 nm after hydrolysis in alkali. Compensation for contaminated 3-methyl-4-nitrophenol is made by subtracting the absorption reading before alkaline hydrolysis. For residue analysis, Sumithion is extracted and measured utilizing a gas chromatograph equipped with either thermionic detector or flame photometric detector. Recovery data of Sumithion by the gas chromatographic method is given for apple, pear, potato, tomato, cucumber, strawberry, onion, fresh milk, rice, soy bean, and green tea. The sensitivity of the method depends on the size of the control value. The control peaks for all samples were low enough to permit measurement at a 0.005 ppm level. It is often easy to determine Sumithion at a level as low as 0.001 ppm.

75-2891. Crossley, J. (Chevron Chem. Co., Richmond, CA). **Tetraethyl pyrophosphate (TEPP).** *IN: Analytical methods for pesticides and plant regulators. Vol. VII,*

Thin-layer and liquid chromatography and analyses of pesticides of international importance. J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 471-477. (14 references)

Tetraethyl pyrophosphate (TEPP), an organophosphorus insecticide, is extremely toxic to both mammals and insects. As a contact insecticide on citrus, deciduous fruit trees, and vegetable crops, its major targets are red spider mites, aphids, and other soft-bodied insects as thrips and leaf-hopper nymphs. Acute oral LD50 for female rats is 1.2 mg/kg; for man, 1.7 mg/kg. The insecticide is available as a 40% technical material or as a 20% emulsive, or as 1 or 3% dusts. The only recommenued method for formulation analysis calls for selective hydrolysis and titration with alkali. For residue analysis the tetraethyl pyrophosphate residues are extracted from crops with chloroform. Nuchar-Celite is used to remove interfering materials and gas chromatography is used to determine TEPP using thermionic detection. Under GLC, although 1 ng can be easily observed, the limit of detectability by GLC is 0.5 ng. For a 50 gm crop sample, this respresents a lower limit of 0.01 ppm on this method.

75-2892. Desmoras, J.; Laurent, M.; Buys, M. (Soc. Usines Chem. Rhone-Poulenc, Vitry-sur-Seine, France). **Vamidothion.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance*. J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 479-494. (20 references)

Vamidothion, a systemic insecticide and acaricide, is converted in plants to the corresponding sulfoxide, both of which are effective against aphids, various mites, suckers, sawflies, thrips, leafhoppers, bugs, and beetles for at least 3 weeks and sometimes 6-8 weeks after application. The acute oral LD50 for the mouse for vamidothion is 37 mg/kg; for vamidothion sulfoxide, 80 mg/kg. The insecticide is available as water miscible solution containing 400 gm/l of vamidothion. The recommended procedure for formulation analysis calls for GLC determination by an internal standard procedure with a moderately polar stationary phase and a thermal conductivity detector. There is an alternative iodimetric method. For residue analysis the determination of vamidothion and sulfoxide residues successively involves extraction by blending the sample in presence of a water-miscible organic solvent, partition cleanup, oxidation of vamidothion and vamidothion sulfoxide to vamidothion sulfone with potassium permanganate, and electron-capture GLC assay of vamidothion sulfone. An alternative colorimetric method calls for similar extraction and partition cleanup procedures. Compounds are then oxidized to inorganic phosphorus, which is determined via the molybdenum blue reaction. An alternative biological method calls for toxicity measurement of sample extract toward *Daphnia pulex* as susceptible organism.

75-2893. Brockelsby, C. H.; Muggleton, D. F. (May Baker Ltd., Dagenham, Essex, England). **Asulam.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance*. J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 497-508. (18 references)

Asulam, methyl(4-aminobenzenesulfonyl)carbamate, a systemic herbicide, is particularly effective against established plants of certain important perennial weeds such as docks and johnsongrass. It is also used in control of bracken, coltsfoot, and lalang, and for pre- and postemergence weed control in sugar cane and oil seed poppy. Mammalian toxicity is low. Acute oral LD50 is greater than 5000 mg/kg to rats, mice, and dogs and greater than 2000 mg/kg to rabbits. Hazards to wildlife are negligible. Asulam is formulated as an aqueous solution containing 40% (w/w) of asulam as sodium salt and is available commercially as "Asulox." The recommended method for formulation analysis calls for titration with sodium nitrite in aqueous solution and with lithium methoxide in nonaqueous solution to determine primary aromatic amine and sulfonylcarbamate groups, respectively. For residue analysis, a colorimetric procedure is recommended for the extraction of free and combined asulum from the plant sample by maceration with acetone and filtration. The aqueous acetone extract is transferred to an alumina column for chromatography from which free and combined asulam are successively eluted with aqueous methanolic ammonia and aqueous hydrochloric acid, respectively. Combined asulam in the latter eluate is converted entirely to the free form by standing with dilute hydrochloric acid at room temperature. Quantitative estimation of asulam in both fractions is effected by diazotization and then coupling with *N*-1-naphthylethylenediamine. To afford a final check of identity, asulum may be characterized by thin-layer chromatography of the colored complex on which quantitative measurements have already been made.

75-2894. Desmoras, J.; Laurent, M.; Petrinko, P.; Buys, M. (Soc. Usines Chim. Rhones-Poulenc, Vitry-sur-Seine, France). **Carbetamide.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance*. J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 509-521. (8 references)

Carbetamide, *N*-phenyl-1-(ethylcarbamoyl) ethylcarbamate, D isomer, is a pre- and postemergence weedkiller for general or selective use. It is used for alfalfa, clover and other forage legumes, chicory, lettuce, cabbage, some garden legumes, rapeseed, caraway, and fennel flower. It is also useful for weed control in orchards, vineyards, nurseries, and for fallowland weed control. Acute oral LD50 for the rat is 11,000 mg/kg; for the mouse, 1,250 mg/kg; and for the dog, 1,000 mg/kg. It is available as Legurame, an emulsifiable concentrate containing 300

gm/l of carbetamide and as Legurame W.P., a wettable powder at 70% carbetamide. The recommended procedure for formulation analysis calls for titrating the ethylamine formed when the herbicide is hydrolyzed in strongly acidic media. The ethylamine is first separated by steam distillation or alternatively in a stream of air. The alternative method of replacing the steam distillation by an air flow is more rapid but necessitates a special apparatus. For residue analysis, carbetamide is extracted from the sample by the appropriate technique depending on the sample being studied. The extract is purified by partition and chromatography on an alumina column. The final determination is carried out by hydrolysis of carbetamide, distillation of aniline, and colorimetry with diazo coupling. In an alternative procedure the purified extract is chromatographed on a thin-layer plate along with the control extract and graded standard amounts of carbetamide. In an alternative biological method the carbetamide concentration of the final solultion after extraction and purification is determined by measuring the growth inhibition of roots of pregerminated barley. The detection limit is generally 0.05 ppm with an initial sample of 500 gm.

75-2895. Pasarela, N. R.; Orloski, E. J. (Am. Cyanamid, Princeton, NJ). **Cycocel plant growth regulant.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 523-544. (6 references)

Cycocel plant growth regulant, containing 2-chloroethyl trimethylammonium chloride (chlormequat), produces varied responses in a wide variety of plant species. Generally, treated plants are compact and sturdy and have shortened internodes. Effects on flowering, fruit set, and tolerance to stress conditions have also been reported. Cycocel has a relatively low mammalian toxicity with single oral LD50 for rats of 670 mg/kg. The chemical is available at several concentrations in aqueous solution. The active ingredient in the technical material and in formulations is determined gravimetrically after precipitation with sodium tetraphenylboron. A colorimetric procedure calls for reacting the Cycocel with dipicrylamine and measuring the resulting chlormequat dipicrylamine salt at 415 nm. For residue analysis, extraction from the prepared sample is carried out with methanol, water-methanol, chloroform-methanol, or acid methanol solvent, the choice depending on the type of sample under study. The residue extract is then purified by cleanup procedures appropriate to sample type. Quantitation is achieved by spectrophotometric measurement of the yellow dipicrylamine-chlormequat complex at 415 nm. Sample handling and extraction procedures are discussed for apples, pears, potatoes, tomatoes, grapes, sugar beets, black currants, wine, cottonseeds, sugar cane, refined sugar, mature grains, wheat straw, green wheat foliage, muscle, fat, liver, kidney, and milk. The sensitivity of the method for a crop depends on the size of the control value. The apparent control for all crops tested ranged from a high of 0.27 ppm for wheat straw to a low of 0.006 ppm for milk.

75-2896. Malina, M. A. (Vesicol Chem. Corp., Chicago, IL). **Dicamba.** *IN: Analytical method for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 545-567. (4 references)

Dicamba, 3,6-dichloro-*o*-anisic acid, is used for postemergence weed control in field corn, wheat, oats, barley, sorghum, pasture/rangeland, perennial grass grown for seed, turfgrass, industrial brush control, and other non-crop land uses. Dicamba is relatively mobile in soil and nonpersistent. It is readily absorbed through both roots and leaves and translocated in the xylem and phloem by most plants. Dissipation of residues can occur by exudation through the roots into the surrounding soil, by tissue metabolism within the plant, and by loss from leaf surfaces. Dicamba is marketed in the form of a 4-lb/gal aqueous solution of the dimethylamine salt, 5% granules, 4-lb/gal oil soluble concentrates, and various mixed formulations with other herbicides. For formulation anlaysis the active ingredient is determined by measuring the IR absorbance at 9.89 μm (1012/cm). Residues of 2-methoxy-3,6-dichlorobenzoic acid and its conversion product, 5-hydroxy-dicamba, in various samples are determined by electron-capture GC by comparing the chromatograms with calibration curves made with methyl 2-methoxy-3,6-dichlorobenzoate and methyl 2,5-dimethoxy -3,6-dichlorobenzoate as standards. The procedure for determining dicamba and 5-hydroxy dicamba residues in all samples of nonfatty solid and body fluid nature utilized a buffered partition column cleanup and gas chromatographic analysis. However, sample preparation prior to analysis is specific for the sample's nature. Subsampling and extraction techniques are given for nonfatty solid samples, soil, nonfatty fluids, and fatty fluids.

75-2897. Voss, G.; Gross, D.; Becker, A.; Guth, J. A. (CIBA-GEIGY, Ltd., Basel, Switzerland). **Fluometuron, metobromuron, chlorbromuron and chloroxuron.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 569-594. (17 references)

The halomethylureas, 3-(3-trifluoromethylphenyl)-1,1- dimethylurea (fluometuron), 3-(4- bromophenyl) -1-methoxy- 1- methylurea (metobromuron), 3-(4-bromo-3-chlorophenyl)-1-methoxy-1- methylurea (chlorbromuron), and 3-[4-(4-chlorophenoxy) phenyl]-1,1-dimethylurea (chloroxuron) and marketed as wettable powder formulations. The most widely used methods for formulation analysis of *N,N*-dimethylureas are based on the quantitative hydrolysis of the herbicides and sub-

sequent determination of the aliphatic and/or aromatic amine fragments. The dimethylamine method is also applicable to fluometuron and chloroxuron. Since metobromuron and chlorbromuron do not yield dimethylamine on hydrolysis, another procedure was designed. A thin-layer chromatographic separation of the active ingredients from interferences followed by ultraviolet absorption spectrometry of methanol extracts gives reliable results. The recommended colorimetric method for residue analysis calls for subjecting the herbicides and their metabolites and/or conjugates to alkaline hydrolysis in the presence of plant or soil material. The resulting anilines are steam distilled and extracted into isooctane by a distillation-extraction head. Subsequent diazotization of the aromatic amines and coupling with a suitable reagent yields a stable dye, which is determined by colorimetry. Interfering azo dyes derived from naturally occurring plant or soil constituents are removed by chromatography on a cellulose column. The colorimetric method is sensitive to about 0.05 ppm of urea herbicide as calculated for a 50 g sample. In the gas chromatographic procedure the material is subjected to alkaline hydrolysis in the presence of plant or soil material. The resulting anilines are steam-distilled and extracted into isooctane. The diazotized aromatic amine is converted to the corresponding iodobenzene derivative by the Sandmeyer iodination reaction. The iodinated derivative is measured by electron-capture GC. This method detects 10 pg of pure standard or at least 0.05 ppm in terms of the original pesticides in crops and soil.

75-2898. Desmoras, J.; Laurent, M.; Petrinko, P.; Buys, M.; Ambrosi, D. (Soc. Usines Chim. Rhones-Poulenc, Vitry-sur-seine, France). **Oxadiazon.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 595-610. (7 references)

Oxadiazon, 2- butyl-4- (2,4-dichloro-5- isopropyloxyphenyl)- 1,3,4-oxadiazoline -5-one, a potent herbicide, is active in pre- and postemergence application on grasses and broadleaf weeds, especially in rice, sugarcane, cotton, soybean, and groundnuts as well as transplanted crops and bulbs. Oxadiazon is used in vineyards, orchards, nurseries, and a number of ornamentals, particularly carnations. It controls bindweed. It is available in Ronstar liquid, an emulsifiable concentrate, containing 250 g/l of active ingredient. Although total chlorine or nitrogen determinations as well as IR or UV spectrometry would be convenient for the determination of oxadiazon in formulations, such methods are liable to interference from formulation additives or impurities. The gas-liquid chromatographic method, the recommended choice, calls for use of the internal standard method on a moderately polar silicone stationary phase with a thermal conductivity detector. Two methods are available for residue analysis. The preferred electron capture GLC, involves extraction with an organic solvent, partition and column chromatographic cleanup, and GLC determination with an electron capture detector. Extraction procedures for residue analysis in various samples are given for plants, soil, milk, meat, and fat. The alternative biological method has the same extraction and cleanup as carried out for GLC. The oxadiazon concentration of the final solution is determined by measuring the growth inhibition of the primary root of millet under light. A supplementary TLC method is also available.

75-2899. Kossmann, K.; Jenny, N. A. (Plant Protect. Div., Schering AG, Berlin, Germany). **Phenmedipham.** *IN: Analytical method for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 611-623. (5 references)

Phenmedipham, methyl-*m*-hydroxycarbanilate *m*-methylcarbanilate, a postemergence herbicide for selective weed control in table beets, acts by absorption through the leaves, inhibiting photosynthetic electron transport. Phenmedipham, the active ingredient in Betanal, is of low acute oral toxicity to animals, and is present in the commercial preparation as a 15.9% emulsifiable concentrate. The recommended method for formulation analysis is based on the Kjeldahl method for nitrogen determination. The sample is digested in concentrated sulfuric acid using mercuric oxide as a catalyst. The digested sample is then made alkaline and the ammonia is distilled out of the sample and titrated with standardized hydrochloric acid. In an alternative TLC method phenmedipham is separated from inert formulation materials by appropriate TLC procedures. Quantitation of phenmedipham is subsequently conducted directly on the TLC plate by reflectance measurement at a wavelength of 240 nm by a chromatogram spectrophotometer. For residue analysis mashed crop samples are alkaki treated to liberate *m*-toluidine from the total phenmedipham residues. The *m*-toluidine is isolated by codistillation and extraction into 2,2,4-trimethylpentane. Finally, the aromatic amine is diazotized and coupled with *N*-(1-naphthyl)-ethylene diammonium dichloride. The resulting azo dye is measured photometrically at wavelength 555 nm.

75-2900. Shell Development Co. (Anal. Dep., Biol. Sci. Res. Cent., Modesto, CA). **Planavin herbicide.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 625-640.

Planavin herbicide, a selective preemergence herbicide whose active ingredient is nitralin or 4-(methylsulfonyl) -2,6-dinitro- *N,N*-dipropylaniline, exerts its effect primarily through the inhibition of cell division in the growing root tips of the germinating seed. It is particularly effective in controlling weedy grasses.

Planavin is commonly marketed as a 75% wettable powder or a 4-lb/gal water-dispersible liquid. Planavin exhibits moderate infrared absorption at 711 K (14.07 *m*m), which is useful for the determination of Planavin herbicide in formulated products. A solution of extracted Planavin is prepared at the 25-35 mg/ml concentration level. Quantitation is achieved by comparing the absorption intensity of the sample solution with that of the standard solution of Planavin. An alternative gas chromatographic procedure calls for preparation of a solution by dissolution or extraction of the formulation to give a Planavin concentration of 1-10 mg/ml. Quantitation is achieved by making a comparison of the peak height or area obtained for the sample solution with a similar measurement for standard solutions of Planavin. For residue analysis on soils, crops, and edible oils, the sample to be analyzed is chopped, ground, macerated, or otherwise processed to effect a homogeneous material and a representative sample is extracted with acetonitrile. An aliquot of the acetonitrile extracts is diluted with aqueous NaCl and extracted with petroleum ether. A portion of the ether is cleaned up on a 5 cm bed of Florisil. An aliquot of the cleaned-up extract is injected into a gas-liquid chromatograph equipped with an electron-capture detector. The resultant elution peak height or area is compared to a calibration curve relating peak height or area to the concentration of pesticides injected.

75-2901. Barney, J. E.; Ja, W. Y.; Patchett, G. G. (Stauffer Chem. Co., Richmond, CA). **Sutan.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 641-643. (2 references)

Sutan, *S*-ethyl diisobutylthiocarbamate (butylate), a selective preplant herbicide, controls most grassy weeds, including nutgrass in corn. Acute oral toxicity to male rats is LD50 4659 mg/kg; acute dermal LD50 in rabbits, greater than 200 mg/kg. The product is available as Sutan 6E, an emulsifiable concentration containing 6 lb Sutan/gal, and also as Sutan 10G, a granular formulation containing 10% Sutan by weight. For formulation analysis Sutan is determined by GC with eptam as the internal standard. Gas chromatography is also used for residue analysis. The detection limit is 0.04 ppm of Sutan in corn and corn plants. Recovery should be in the area of 80% to 90% when the steam distillation condenser is properly rinsed following the distillation. Recovery data is given for corn ears, fresh and dried, and corn plants, green and dry.

75-2902. Pease, H. L.; Gardiner, J. A. Holt, R. F. (E. I. Du Pont de Nemours and Co., Wilmington, DE). **Benomyl.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 647-655. (3 references)

Benomyl, methyl 1-(butylcarbamoyl)-2- benzimidazolecarbamate, a fungicide with both preventive and curative properties, is used as a foliar treatment at low dosage rates for control of a wide range of fungus diseases affecting fruits, vegetables, field crops, and ornamentals. Acute oral toxicity in fasted rats was greater than 10,000 mg/kg. Benlate (benomyl) fungicide and Tersan 1991 turf fungicide are commercial wettable powders each containing 50% active ingredient. For residue analysis either direct fluorometric measurement or colorimetric analysis is used following bromination after conversion to 2-benzimidazolecarbamate, then to 2-aminobenzimidazole by a two-stage acid-base hydrolysis procedure, after prior extraction from the sample substrate with an organic solvent. The extract is purified by liquid-liquid partition techniques.

75-2903. Pease, H. L.; Reiser, R. W. (E. I. Du Pont de Nemours and Co., Wilmington, DE). **Chloroneb.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 657-664. (3 references)

Chloroneb, 1,4-dichloro-2,5-dimethoxybenzene, a fungicide, is used as a supplemental seed treatment or as an in-furrow soil treatment at planting time to control *Rhizoctonia* and *Pythium* species and *Sclerotium rolfsii*. The product is available as a wettable powder containing 65% active ingredient. Formulations of chloroneb are assayed by gas chromatography. The peak area ratio calibration technique is used with biphenyl as internal standard. Chloroform-insoluble formulating ingredients are removed by filtration prior to analysis. For residue analysis, chloroneb and its metabolite, 2,5-dichloro -4- methoxyphenol, are determined using programmed temperature microcoulometric GC to measure each compound after separation from the sample by steam distillation.

75-2904. Yuen, S. H. (Plant Protect., Ltd., Bracknell, Berkshire, England). **Drazoxolon.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance.* J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 665-673. (4 references)

Drazoxolon, 4-(2-chlorophenylhydrazono) -3-methyl- 5- isoxazolone, is a foliage fungicide, effective particularly against powdery mildew on ornamentals, cereals, black currants, apples, peaches, pears, and grapes. It acts as a protectant, preventing germination of fungal spores. Against powdery mildews, however, it has a very marked eradicant action. The compound has moderate oral, but low dermal toxicity to mammals. Acute oral LD50 to rats is 126 mg/kg. It appears on the market as "Mil-Col," a 40% formulation. For formulation analysis drazoxolon is dissolved in dilute sodium hydroxide solu-

tion. The diluted product is acidified and extracted with chloroform. The absorbance of the yellow extract is measured differentially at 400 nm. For residue analysis the sample is macerated with chloroform and the filtered extract is washed with *N* hydrochloric acid. Drazoxolon is then extracted from the chloroform into dilute sodium hydroxide solution. The extract is purified by repeated washing with chloroform, acidified, and reextracted with chloroform. The absorbance of the filtered extract is measured at 400 nm. Data from recovery experiments on cucumbers, gooseberries, apples, pears, and grapes is given. The absorbances of final solutions at 400 nm obtained on a number of these samples ranged from 0.002 to 0.051, equivalent to 0-0.07 ppm of apparent drazoxolon, with a mean of 0.03 ppm, based on which the limit of determination for the method is 0.05 ppm.

75-2905. Schroeder, C. H.; Sherma, J. (W.A.R.F. Inst., Inc., Madison, WI). **Warfarin.** *IN: Analytical methods for pesticides and plant growth regulators. Vol. VII, Thin-layer and liquid chromatography and analyses of pesticides of international importance*. J. Sherma and G. Zweig, Eds., Academic Press, New York, 1973, p. 677-688. (11 references)

Warfarin, 3(α-acetonylbenzyl) -4- hydroxycoumarin, is ordinarily supplied to rodenticide bait formulators in a concentration of 0.5%. Finished cereal baits containing 0.025% warfarin are commercially available for rat and mouse control. Baits containing 0.05% warfarin are also available commercially. In addition to its use in rodenticide formulations, warfarin sodium salt is used in tablet form as a pharmaceutical product. For warfarin concentrations of 0.5% warfarin on cornstarch, formulation analysis calls for the extraction of the test material with a hexane-ether mixture, which is then washed with hydrochloric acid. Sodium pyrophosphate converts the warfarin to its sodium derivative, which partitions exclusively to the aqueous phase. The aqueous alkaline phase is purified by ether and hexane washings and the absorbance is determined at 308 nm and compared to standard recovery extractions, which are carried out concurrently. In baits where substantial interfering materials exist, it is suggested that chromatograpic cleanup be incorporated into the procedures. In cases where warfarin commercial baits contain high levels of fats or oils, the warfarin is extracted initially with ether. Additional procedures are given for those baits that contain large amounts of interfering substances or those baits that cannot be extracted quantitatively by 1% sodium pyrophosphate solution and do not contain sufficient interfering material to warrant chromatographic cleanup. For residue analysis a spectrophotometric method is used for the detection of warfarin at concentrations as low as 1 to 2 ppm in materials to which warfarin may have been inadvertently added. The determination of warfarin concentrations in blood plasma incorporates solvent extraction of the warfarin from acidic plasma. Cleanup is effected by mild alkaline wash followed by conversion of the warfarin to its sodium derivative with strong alkali, with concomitant partition of the sodium warfarin to the aqueous alkaline solution. The warfarin concentration is estimated from the absorbance measured at 308 nm. Gas chromatographic procedures have been used for determination of warfarin in plant coumarins and in liver tissue. A thin layer chromatographic method is also presented for detection of warfarin in organic materials.

See also **75-2584** **75-2605**

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